

**YAMAHA LINEAR MOTOR ROBOTS PHASER series**

# MR<sub>Type</sub>

**User's Manual**

ENGLISH



**YAMAHA MOTOR CO., LTD.**

**IM Operations**

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URL <http://www.yamaha-motor.jp/robot/index.html>

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## MEMO

# Introduction

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Thank you for purchasing this YAMAHA linear single-axis robot MR Type.

This user's manual describes the safety measures, handling, adjustment and maintenance of the MR type robots for correct, safe and effective use.

Be sure to read this manual carefully before installing the MR type robots. Even after you have read this manual, keep it in a safe and convenient place for future reference.

- This user's manual should be used with the robot and considered an integral part of it. When the robot is moved, transferred or sold, send this manual to the new user along with the robot. Be sure to explain to the new user the need to read through this manual.
- Specifications of robot models other than standard models may be omitted in this manual if they are common to those of standard models. In this case, refer to the specifications of standard models.
- For details on specific operation of the robot, refer to the separate user's manual for the robot controller being used.

## NOTES

- ◆ The contents of this manual are subject to change without prior notice.
- ◆ While every effort has been made to ensure the contents of this manual are correct, please contact us if you find any part of this manual to be unclear, confusing or inaccurate.

YAMAHA MOTOR CO., LTD.  
IM Operations

**MEMO**



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## 1-1 Safety information

Industrial robots are highly programmable, mechanical devices that provide a large degree of freedom when performing various manipulative tasks. To ensure correct and safe use of YAMAHA industrial robots, carefully read this manual and make yourself well acquainted with the contents. FOLLOW THE WARNINGS, CAUTIONS AND INSTRUCTIONS included in this manual. Failure to take necessary safety measures or mishandling due to not following the instructions in this manual may result in trouble or damage to the robot and injury to personnel (robot operator or service personnel) including fatal accidents.

Warning symbols and signal words used in this manual are classified as explained below. Make sure that you fully understand the meaning of each symbol and comply with the instructions.



### **DANGER**

**FAILURE TO FOLLOW DANGER INSTRUCTIONS WILL RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS INSPECTING OR REPAIRING THE ROBOT.**



### **WARNING**

**FAILURE TO FOLLOW WARNING INSTRUCTIONS COULD RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS INSPECTING OR REPAIRING THE ROBOT.**



### **CAUTION**

**Failure to follow CAUTION instructions may result in injury to the robot operator, bystanders or persons inspecting or repairing the robot, or damage to the robot and/or robot controller.**



### **NOTE**

Explains the key point in the operation in a simple and clear manner.



### **Reference**

Gives useful information related to the robot operation.

Refer to the user's manual by any of the following methods to operate or adjust the robot safely and correctly.

1. Operate or adjust the robot while referring to the printed version of the user's manual (available for an additional fee).
2. Operate or adjust the robot while viewing the CD-ROM version of the user's manual on your computer screen.
3. Operate or adjust the robot while referring to a printout of the necessary pages from the CD-ROM version of the user's manual.

*It is not possible to list all safety items in detail within the limited space of this manual. So it is essential that the user have a full knowledge of basic safety rules and also that the operator makes correct judgments on safety procedures during operation.*

*For specific safety information and standards, refer to the applicable local regulations and comply with the instructions. This manual and warning labels supplied with or attached to the robot are written in English. Unless the robot operators or service personnel understand English, do not permit them to handle the robot.*

\* Cautions regarding the official language of EU countries

For equipment that will be installed in EU countries, the language used for the user's manuals, CE declarations, and operation screen characters is English only. Warning labels only have pictograms or else include warning messages in English. In the latter case, Japanese messages might be added.

## 1-2 Essential precautions

Particularly important cautions for handling or operating the robot are described below. In addition, precautions during installation, operation, inspection and maintenance are also provided in each chapter. Be sure to comply with these instructions to ensure safe use of the robot.

### (1) Observe the following cautions during automatic operation.

- Install a safeguard (protective enclosure) to keep any person from entering within the movement range of the robot and suffering injury due to being struck by moving parts.
- Install a safety interlock that triggers emergency stop when the door or panel is opened.
- Install safeguards so that no one can enter inside except from doors or panels equipped with safety interlocks.
- Warning labels 1 are supplied with the robot and should be affixed to conspicuous spots on doors or panels equipped with safety interlocks.



#### **DANGER**

**SERIOUS INJURY OR DEATH WILL RESULT FROM IMPACT WITH MOVING ROBOT.**

- **KEEP OUTSIDE OF GUARD DURING OPERATION.**
- **LOCK OUT POWER BEFORE APPROACHING ROBOT.**

Warning label 1



### (2) Use caution to prevent hands or fingers from being pinched or crushed.

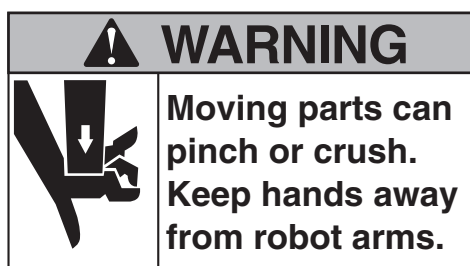
Warning label 2 is affixed to the robot.



#### **WARNING**

**MOVING PARTS CAN PINCH OR CRUSH.  
KEEP HANDS AWAY FROM ROBOT ARMS.**

## Warning label 2



## (3) Follow the instructions on warning labels and in this manual.

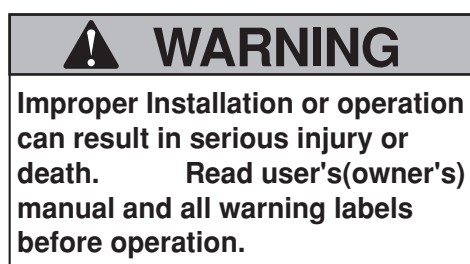
- Be sure to read the warning labels and this manual carefully and make sure you thoroughly understand their contents before attempting installation and operation of the robot.
- Before starting robot operation, be sure to reread the procedures and cautions relating to your work as well as descriptions in this chapter (Chapter 1, "Using the Robot Safely").
- Never install, adjust, inspect or service the robot in any manner that does not comply with the instructions in this manual.
- The warning labels 3 are supplied with the robot and should be affixed to the robot or conspicuous spots near the robot.

**WARNING**

**IMPROPER INSTALLATION OR OPERATION CAN RESULT IN SERIOUS INJURY OR DEATH.**

**READ THE USER'S MANUAL AND ALL WARNING LABELS BEFORE OPERATION.**

## Warning label 3



## (4) Be aware of strong magnets inside the robot.

**WARNING**

**POWERFUL MAGNETS ARE INSTALLED INSIDE THE ROBOT. DO NOT DISASSEMBLE THE ROBOT SINCE THIS MAY CAUSE INJURY. DEVICES THAT MIGHT MALFUNCTION DUE TO MAGNETIC FIELDS MUST BE KEPT AWAY FROM THIS ROBOT.**

- (5) Do not remove, alter or stain the warning labels.




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**WARNING**

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IF WARNING LABELS ARE REMOVED OR DIFFICULT TO SEE, THEN ESSENTIAL PRECAUTIONS MIGHT NOT BE TAKEN, RESULTING IN ACCIDENTS.

- DO NOT REMOVE, ALTER OR STAIN THE WARNING LABELS ON THE ROBOT.
  - DO NOT ALLOW THE WARNING LABELS TO BE HIDDEN BY DEVICES INSTALLED ONTO THE ROBOT BY THE USER.
  - PROVIDE PROPER LIGHTING SO THAT THE SYMBOLS AND INSTRUCTIONS ON THE WARNING LABELS CAN BE CLEARLY SEEN EVEN FROM OUTSIDE THE SAFEGUARD ENCLOSURE.
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- (6) Do not use the robot in environments containing inflammable gas, etc.




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**WARNING**

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- THIS ROBOT WAS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OR EXPLOSIVE SUBSTANCES ARE PRESENT.
  - DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS. EXPLOSIONS OR FIRE MIGHT OTHERWISE RESULT.
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- (7) Do not use the robot in locations possibly subject to electromagnetic interference, etc.




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**WARNING**

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AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MIGHT OTHERWISE OCCUR.

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- (8) Provide safety measures for end effector (gripper, etc.).




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**WARNING**

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- END EFFECTORS MUST BE DESIGNED AND MANUFACTURED SO THAT THEY CREATE NO HAZARDS (FOR EXAMPLE, A WORKPIECE THAT COMES LOOSE) EVEN IF POWER (ELECTRICITY, AIR PRESSURE, ETC.) IS SHUT OFF OR POWER FLUCTUATIONS OCCUR.
  - IF THERE IS A POSSIBLE DANGER THAT THE OBJECT GRIPPED BY THE END EFFECTOR MAY FLY OFF OR DROP, THEN PROVIDE APPROPRIATE SAFETY PROTECTION TAKING INTO ACCOUNT THE OBJECT SIZE, WEIGHT, TEMPERATURE AND CHEMICAL PROPERTIES.
-

- (9) Be careful not to touch the motor and peripheral parts when hot.

**WARNING**

The motor and speed reduction gear casing are extremely hot after automatic operation, so burns may occur if these are touched. Before handling these parts during inspection or servicing, turn off the controller, wait for a while and check that the parts have cooled.

- (10) Take the following safety precautions during inspection of controller.

**WARNING**

- WHEN YOU NEED TO TOUCH THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER DURING INSPECTION, ALWAYS FIRST TURN OFF THE CONTROLLER POWER SWITCH AND ALSO THE POWER SOURCE IN ORDER TO PREVENT POSSIBLE ELECTRICAL SHOCK.
- DO NOT DISASSEMBLE THE CONTROLLER. NEVER TOUCH ANY PART INSIDE THE CONTROLLER. DOING SO MAY CAUSE BREAKDOWN, MALFUNCTION, INJURY OR FIRE. IF ANY PART OF THE CONTROLLER NEEDS TO BE REPLACED, ALWAYS FOLLOW THE INSTRUCTIONS GIVEN BY YAMAHA.
- REFER TO THE YAMAHA ROBOT CONTROLLER USER'S MANUAL FOR PRECAUTIONS ON HANDLING THE CONTROLLER.

- (11) Consult us for corrective action when the robot is damaged or malfunctions occur.

**WARNING**

IF ANY PART OF THE ROBOT IS DAMAGED OR ANY MALFUNCTION OCCURS, CONTINUING THE OPERATION MAY BE VERY DANGEROUS. PLEASE CONSULT YOUR YAMAHA SALES OFFICE OR DEALER FOR CORRECTIVE ACTION.

Damage or Trouble	Possible Danger
Damage to machine harness or robot cable	Electrical shock, malfunction of robot
Damage to exterior of robot	Flying outwards of damaged parts during robot operation
Abnormal operation of robot (positioning error, excessive vibration, etc.)	Malfunction of robot

- (12) Protective bonding

**WARNING**

BE SURE TO GROUND THE ROBOT AND CONTROLLER TO PREVENT ELECTRICAL SHOCK.



- (13) Be sure to make correct parameter settings.



**CAUTION**

The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If these are not correct, drive unit service life may end prematurely, and damage to robot parts or residual vibration during positioning may result.

- (14) Follow the specified procedures when installing, adjusting or inspecting the robot.



**WARNING**

ALWAYS FOLLOW THE SPECIFIED PROCEDURES WHEN INSTALLING, ADJUSTING OR INSPECTING THE ROBOT. NEVER ATTEMPT ANY PROCEDURE NOT DESCRIBED IN THIS MANUAL.

- (15) Do not attempt any repair, parts replacement and modification.



**WARNING**

DO NOT ATTEMPT ANY REPAIR, PARTS REPLACEMENT AND MODIFICATION UNLESS DESCRIBED IN THIS MANUAL. THESE WORKS REQUIRE TECHNICAL KNOWLEDGE AND SKILL, AND MAY ALSO INVOLVE WORK HAZARDS.

- (16) Do not use the robot in locations where strong magnetic sources are present.



**WARNING**

DO NOT USE THE ROBOT NEAR A STRONG MAGNETIC SOURCE. THE ROBOT MIGHT OTHERWISE BREAK DOWN OR MALFUNCTION.

- (17) Precautions when disposing of the robot

When disposing of the robot, handle it as industrial waste.



**WARNING**

HANDLE THE ROBOT CAREFULLY WHEN DISPOSING OF IT SINCE POWERFUL MAGNETS ARE INSTALLED INSIDE.

- (18) Location for installing the controller and the programming box

The robot controller and programming box should be installed at a location that is outside the robot movement range yet where it is easy to operate and view the robot performing tasks.

- (19) Protect electrical wiring and hydraulic/pneumatic hoses as needed.

Install a cover or similar item to protect the electrical wiring and hydraulic/pneumatic hoses from possible damage.

**(20) Install an operation status light.**

Install an operation status light (signal light tower, etc.) at an easy-to-see position so the operator will know whether the robot is merely stopped or is in emergency-error stop.

**(21) Clean work tools, etc.**

Work tools such as welding guns and paint nozzles which are mounted in the robot arm will preferably be cleaned automatically.

**(22) Provide adequate lighting.**

Make sure to provide enough lighting to ensure safety during work.

**(23) Prevent the gripped object from flying outwards.**

If the object or workpiece gripped by the robot might fly outward or drop and create a hazard to the operator, then protective equipment should be installed by taking the size, weight, temperature and chemical properties of the object into account.

**(24) Draw up "work instructions" and makes sure the operator learns them well.**

Decide on "work instructions" for the following items in cases where personnel must work within the robot movement range to perform teaching, maintenance or inspection. Make sure the workers know these "work instructions" well.

- (1) Robot operating procedures needed for tasks such as startup procedures and handling switches
- (2) Robot speeds used during tasks such as teaching
- (3) Methods for workers to signal each other when two or more workers perform tasks
- (4) Steps that the worker should take when a problem or emergency occurs
- (5) Steps to take after the robot has come to a stop when the emergency stop device was triggered, including checks for cancelling the problem or error state and safety checks in order to restart the robot.
- (6) In cases other than above, the following actions should be taken as needed to prevent hazardous situations due to sudden or unexpected robot operation or faulty robot operation, as listed below.
  1. Show a display on the operator panel
  2. Ensure the safety of workers performing tasks within the robot movement range
  3. Clearly specify position and posture during work  
Position and posture where worker can constantly check robot movements and immediately move to avoid trouble if an error/problem occurs
  4. Install noise prevention measures
  5. Use methods for signaling operators of related equipment
  6. Use methods to decide that an error has occurred and identify the type of error

Implement the "work instructions" according to the type of robot, installation location, and type of work task.

When drawing up the "work instructions", make an effort to include opinions from the workers involved, equipment manufacture's technicians, and workplace safety consultants, etc.

**(25) Display a sign on operation panel during work**

Display an easy to understand sign or message on the programming box and operation panel during the job task, to prevent anyone other than the operators for that job task from mistakenly operating a start or selector switch. If needed, take other measures such as locking the cover on the operation panel.

**(26) Make daily and periodic inspections.**

- (1) Always make sure that daily and periodic inspections are performed, and make a pre-work check to ensure there are no problems with the robot or related equipment. If a problem or abnormality is found, then promptly repair it or take other measures as necessary.
- (2) When you make periodic inspections or repairs, make a record and store it for at least 3 years.

## **1-3 Industrial robot operating and maintenance personnel**

Operators or persons who handle the robot such as for teaching, programming, movement check, inspection, adjustment, and repair must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must read the user's manual carefully to understand its contents before attempting the robot operation.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and safety standards for industrial robots.

## 1-4 Robot safety functions

1

Using the Robot Safely

### (1) Overload detection

This function detects an overload applied to the motor and shuts off the servo power.

### (2) Overheat detection

This detects an abnormal temperature rise in the controller driver and shuts off the servo power.

If an overload or overheat error occurs, take the following measures.

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

### (3) Soft limits

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation.

Note: The working envelope is the area limited by soft limits.



#### WARNING

**SOFT LIMITS MUST BE SET WITHIN THE MOVEMENT RANGE (MECHANICAL STOPPER). IF THE SOFT LIMIT IS SET OUTSIDE THE MOVEMENT RANGE, THE ROBOT AXIS MAY COLLIDE WITH THE MECHANICAL STOPPER AT HIGH SPEED, CAUSING THE OBJECT GRIPPED BY THE END EFFECTOR TO FLY OR DROP AND THE ROBOT TO MALFUNCTION.**

### (4) Mechanical stoppers

If the servo power is suddenly shut off during high-speed operation by emergency stop or safety functions, these mechanical stoppers prevent the axis from exceeding the movement range. The movement range is the area limited by mechanical stoppers.



#### WARNING

**ROBOT MOVEMENT WILL NOT STOP IMMEDIATELY AFTER THE SERVO POWER SUPPLY IS SHUT OFF BY EMERGENCY STOP OR OTHER SAFETY FUNCTIONS.**



#### WARNING

**WHEN THE SLIDER (CARRIAGE) COLLIDES WITH THE MECHANICAL STOPPER, THIS MIGHT DAMAGE THE PARTS OF THE ROBOT. AFTER A COLLISION, CHECK THAT NO PARTS OF THE ROBOT ARE DAMAGED.**

## 1-5 Safety measures for the system

Since the robot is commonly used in conjunction with an automated system, dangerous situations are more likely to occur from the automated system than from the robot itself. Accordingly, appropriate safety measures must be taken on the part of the system manufacturer according to the individual system. The system manufacturer should provide a proper instruction manual for safe, correct operation and servicing of the system.

## 1-6 Trial operation

After making installations, adjustments, inspections, or maintenance or repairs to the robot, make a trial run using the following procedures.

- (1) If a safeguard enclosure has not yet been provided right after installation of the robot, rope off or chain off around the movement area of the manipulator in place of the safeguard, and observe the following points.**
  1. Use sturdy, stable posts which will not fall over easily.
  2. The rope or chain should be easily visible by everyone around the robot.
  3. Place a sign to keep the operator or other personnel from entering the movement range of the manipulator.
- (2) Check the following points before turning on the controller.**
  1. Is the robot securely and correctly installed?
  2. Are the electrical connections to the robot correct?
  3. Are items such as air pressure correctly supplied?
  4. Is the robot correctly connected to peripheral equipment?
  5. Have safety measures (safeguard enclosure, etc.) been taken?
  6. Does the installation environment meet the specified standards.
- (3) After the controller is turned on, check the following points from outside the safeguard enclosure.**
  1. Does the robot start and stop as intended? Can the operation mode be selected correctly?
  2. Does each axis move as intended within the soft limits?
  3. Does the end effector move as intended?
  4. Are the signal transmissions to the end effector and peripheral equipment correct?
  5. Does emergency stop work?
  6. Are the teaching and playback functions normal?
  7. Are the safeguard enclosure and interlock working as intended?
  8. Does the robot move correctly during automatic operation?

**Reference**

When starting the PHASER series robots, the slider always moves a few millimeters right after the servo is turned on and emits a high pitched noise. This is just the routine pre-action for finding the magnetic pole and is not a problem.

## 1-7 Work within the safeguard enclosure

### (1) Work within the safeguard enclosure

When work is required inside the safeguard enclosure, always turn off the controller and place a sign indicating that the robot is being adjusted or serviced in order to keep any other person from touching the controller switch or operation panel, except for the following cases.

- 1) Soft limit settings
- 2) Teaching

For item 1), follow the precautions and procedure for each section. To perform item 2), refer to the description in (2) below.

### (2) Teaching

When performing teaching within the safeguard enclosure, comply with the instructions listed below.

- 1) Check or perform the following points from outside the safeguard enclosure.
  1. Make sure that no hazards are present within the safeguard enclosure by a visual check.
  2. Check that the programming box HPB (option) operates correctly.
  3. Check that no failures are found in the robot.
  4. Check that emergency stop works correctly.
  5. Select teaching mode and prohibit automatic operation.
- 2) Never enter the movement range of the manipulator while within the safeguard enclosure.

## 1-8 Automatic operation

Automatic operation described here includes all operations in AUTO mode.

**(1) Check the following before starting automatic operation.**

1. No one is within the safeguard enclosure.
2. The programming box and tools are in their specified locations.
3. The alarm or error lamps on the robot and peripheral equipment do not flash.
4. The safeguard enclosure is securely installed with safety interlocks actuated.

**(2) Observe the following during automatic operation or in cases where an error occurs.**

- 1) After automatic operation has started, check the operation status and signal light to ensure that the robot is in automatic operation.
- 2) Never enter the safeguard enclosure during automatic operation.
- 3) If an error occurs in the robot or peripheral equipment, observe the following procedure before entering the safeguard enclosure.
  1. Press the emergency stop button to set the robot to emergency stop.
  2. Place a sign on the start switch, indicating that the robot is being inspected in order to keep any other person from touching the start switch and restarting the robot.

## 1-9 Warranty

For information on the warranty period and terms, please contact our distributor where you purchased the product.

■ **This warranty does not cover any failure caused by:**

1. Installation, wiring, connection to other control devices, operating methods, inspection or maintenance that does not comply with industry standards or instructions specified in the YAMAHA manual;
2. Usage that exceeded the specifications or standard performance shown in the YAMAHA manual;
3. Product usage other than intended by YAMAHA;
4. Storage, operating conditions and utilities that are outside the range specified in the manual;
5. Damage due to improper shipping or shipping methods;
6. Accident or collision damage;
7. Installation of other than genuine YAMAHA parts and/or accessories;
8. Modification to original parts or modifications not conforming to standard specifications designated by YAMAHA, including customizing performed by YAMAHA in compliance with distributor or customer requests;

9. Pollution, salt damage, condensation;
10. Fires or natural disasters such as earthquakes, tsunamis, lightning strikes, wind and flood damage, etc;
11. Breakdown due to causes other than the above that are not the fault or responsibility of YAMAHA;

■ **The following cases are not covered under the warranty:**

1. Products whose serial number or production date (month & year) cannot be verified.
2. Changes in software or internal data such as programs or points that were created or changed by the customer.
3. Products whose trouble cannot be reproduced or identified by YAMAHA.
4. Products utilized, for example, in radiological equipment, biological test equipment applications or for other purposes whose warranty repairs are judged as hazardous by YAMAHA.

THE WARRANTY STATED HEREIN PROVIDED BY YAMAHA ONLY COVERS DEFECTS IN PRODUCTS AND PARTS SOLD BY YAMAHA TO DISTRIBUTORS UNDER THIS AGREEMENT. ANY AND ALL OTHER WARRANTIES OR LIABILITIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXPRESSLY DISCLAIMED BY YAMAHA. MOREOVER, YAMAHA SHALL NOT BE HELD RESPONSIBLE FOR CONSEQUENT OR INDIRECT DAMAGES IN ANY MANNER RELATING TO THE PRODUCT.



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## 2-1 Checking the product

After unpacking, make sure that all components and accessories are included (as specified in your order). Also check the product for any damage on the exterior which might have occurred during shipping.

If there are any missing parts or damage due to shipping, please notify your YAMAHA sales office or representative immediately.



### WARNING

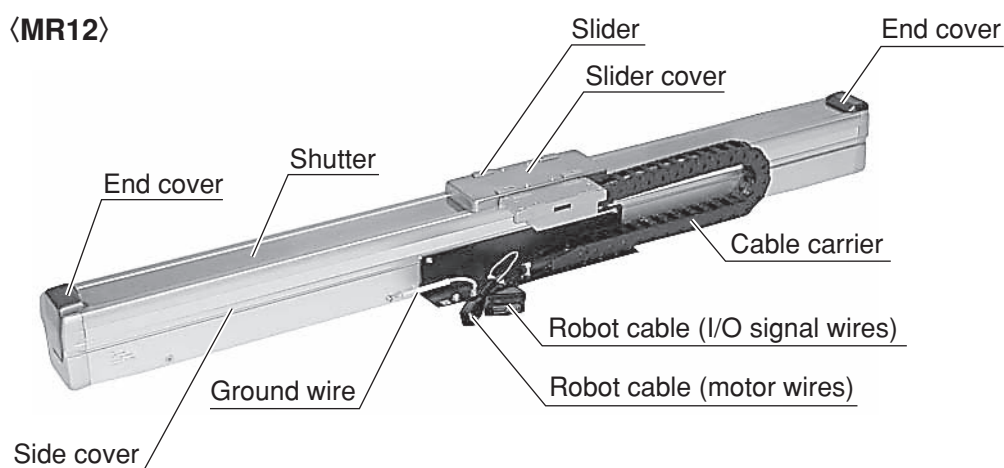
- ALWAYS USE 2 PEOPLE TO TAKE THE ROBOT UNIT OUT OF THE PACKAGE. EACH PERSON SHOULD GRIP THE ROBOT UNIT NEAR ONE END FROM THE LOWER SIDE. CARRY WITH THE ROBOT FACING UPWARD (SLIDER SIDE UPWARDS).
- WHEN UNPACKING, CAREFULLY HOLD THE ROBOT NOT TO DROP IT. IF THE ROBOT FALLS, SERIOUS INJURY MAY OCCUR OR THE ROBOT MAY BE DAMAGED.

## 2-2 Robot part names

### Robot part names

External components

〈MR12〉



### Reference

The direction of the cables coming out of the cable carrier depends on the specifications you ordered. The above illustration shows an example of RH (right and horizontal) type.

## 2-3 Robot internal structure

The YAMAHA linear single-axis robot PHASER series is a truly innovative single-axis robot using a shaft motor as its drive source. The internal robot structure and features are described here.

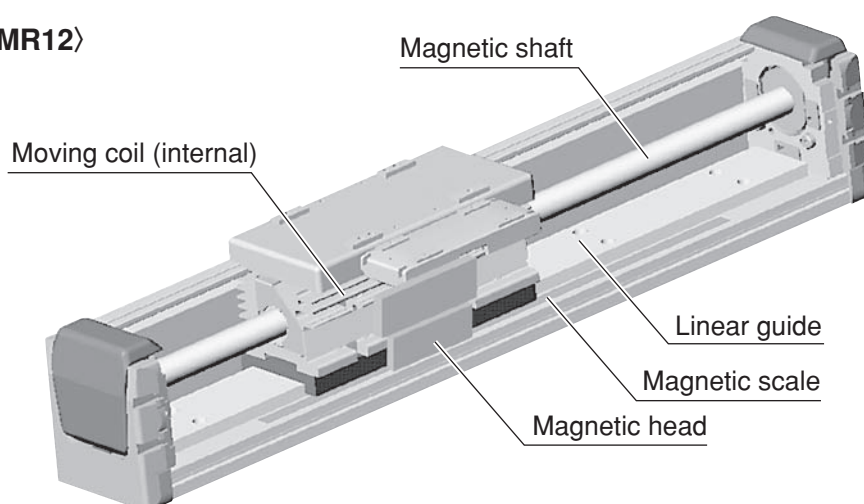


### WARNING

THE FOLLOWING DRAWINGS AND DESCRIPTIONS ARE GIVEN TO ASSIST IN UNDERSTANDING AND SAFELY USING THE PHASER SERIES ROBOTS. DO NOT ATTEMPT TO DISASSEMBLE THE ROBOT. POWERFUL PERMANENT MAGNETS ARE FIXED BY ADHESIVE TO THE MAGNETIC PLATE SO DISASSEMBLY WITHOUT PROPER PREPARATION IS HAZARDOUS. ALSO, THE REQUIRED PERFORMANCE MAY NOT BE OBTAINED.

### PHASER series internal layout

〈MR12〉



### Magnetic shaft

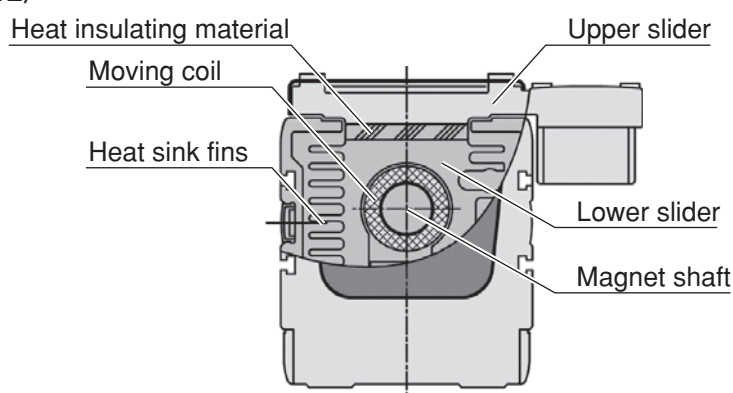
The interior of the shaft contains powerful permanent magnets laid out at equally spaced intervals. The magnetic field generated by these permanent magnets is utilized as propulsive power by the robot. The material of the pipe on the shaft surface is stainless steel.

### Moving coil

The lower slider contains an internal coil. Passing current through this coil changes the magnetic force into a propulsive force. Passing current through the coil also generates heat but heat sink fins efficiently dissipate this heat. An insulation layer is installed between the upper slider and work piece clamp surface to prevent heat from propagating to the work clamp surface.

## Heat insulating structure

### 〈MR12〉



### Linear guide

The MR12 uses a linear guide assembled with a ball retainer that efficiently eliminates friction between adjacent balls. This achieves low noise, long service life and long maintenance-free operation.

### Magnetic scale and magnetic head

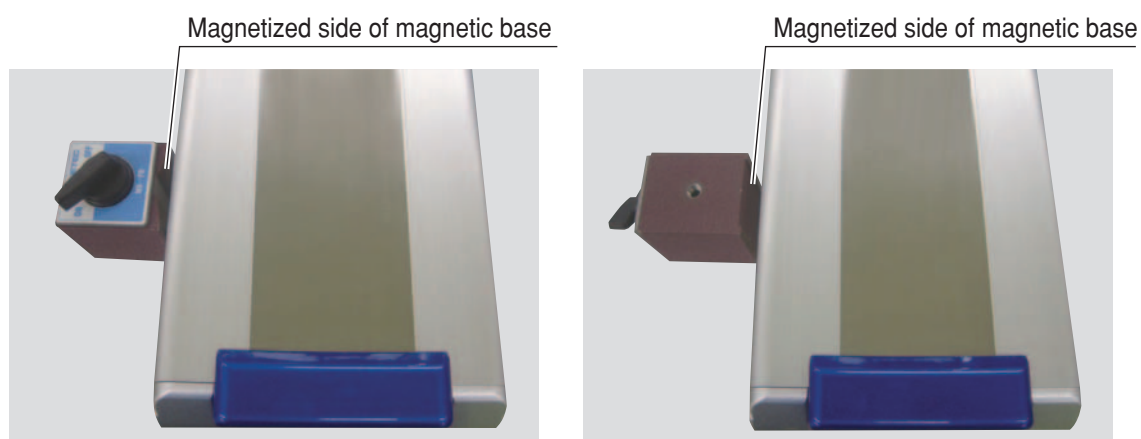
The magnetic scale utilizes YAMAHA's superb magnetic signal detection technology developed in-house. The scale is made of a special alloy that retains a high-strength magnetic field with virtually no weakening over time. Integrating it with a magnetic head yields an astonishingly high resolution of one micrometer. Fully closed control directly detects the table (slider) position for stable and highly precise positioning.



### CAUTION

**Do not bring a strong magnet close to the magnetic scale. A strong magnet may erase the information recorded on the scale and cause the robot to malfunction. A magnetic force of about 10mT (100 Gauss) does not cause any problem.**

**As shown in the photos below, for example, bringing the magnetized side of a magnetic base close to the side of the robot may erase the information on the magnetic scale, so use caution.**



## MEMO

### Contents

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## 3-1 Carrying the robot

Always use two people to carry the robot unit. Each person should grip the robot unit near one end from the lower side as shown and carry with the load well balanced. Carry with the robot facing upward (slider side upwards).

**Hold and carry as shown**



### WARNING

**ALWAYS OBSERVE THE FOLLOWING PRECAUTIONS WHEN CARRYING THE ROBOT.**

- REMOVE ANY AND ALL OBJECTS SUCH AS HANDS AND GRIPPERS ATTACHED TO THE ROBOT SLIDER BEFORE MOVING THE ROBOT. THE SLIDER WILL LOSE BALANCE IF MOVED WITH OBJECTS STILL ATTACHED AND CAUSE INJURIES.
- KEEP THE ROBOT BALANCED AND DON'T LET IT TILT WHILE MOVING IT. IF THE ROBOT TILTS, THE SLIDER MAY MOVE UNDER ITS OWN WEIGHT CAUSING SERIOUS INJURIES SUCH AS CRUSHED FINGERS.
- NEVER ATTEMPT TO HOLD THE ROBOT BY ANY OF THE WRONG EXAMPLES SHOWN IN THE PHOTOS IN THE NEXT PAGE.

**Never try this when moving!**



Do not carry by holding the slider.



Do not carry by holding the cable.



Do not carry by holding the cable carrier.



Do not carry by gripping the end cover.

## 3-2 Robot Installation Conditions

### 3-2-1 Installation environments

Be sure to install the robot in the following environments.

Items	Specifications
Allowable ambient temperature	10 to 40°C
Allowable ambient humidity	35 to 85% RH (no condensation)
Altitude	0 to 1000 meters above sea level
Ambient environments	Avoid installing near water, cutting water, oil, dust, metallic chips and organic solvent.
	Avoid installation near corrosive gas and corrosive materials.
	Avoid installation in atmosphere containing inflammable gas, dust and liquid.
	Avoid installation near objects causing electromagnetic interference, electrostatic discharge and radio frequency interference.
Vibration	Do not subject to impacts or vibrations.
Working space	Allow sufficient space margin to perform jobs (teaching, inspection, repair, etc.)

For detailed information on how to install the robot controller, refer to the separate "YAMAHA Robot Controller User's Manual".



#### **WARNING**

**AVOID INSTALLING THE ROBOT IN LOCATIONS WHERE THE AMBIENT CONDITIONS MAY EXCEED THE ALLOWABLE TEMPERATURE OR HUMIDITY, OR IN ENVIRONMENTS WHERE EXCESSIVE MOISTURE, CORROSIVE GASES, METALLIC POWDER OR DUST ARE GENERATED. MALFUNCTIONS, FAILURES OR SHORT CIRCUITS MAY OTHERWISE RESULT.**



#### **WARNING**

- THIS ROBOT WAS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OR EXPLOSIVE SUBSTANCES ARE PRESENT.
- DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS. EXPLOSIONS OR FIRE COULD OTHERWISE RESULT.

**WARNING**

**AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MAY OTHERWISE OCCUR.**

**WARNING**

**DO NOT USE THE ROBOT IN LOCATIONS SUBJECT TO EXCESSIVE VIBRATION. ROBOT INSTALLATION BOLTS MAY OTHERWISE BECOME LOOSE CAUSING THE ROBOT TO FALL OVER.**

**3**

### 3-2-2 Installation base

To mount the robot, use an installation base that satisfies the following conditions.

- 1) The installation base is subjected to a great deal of stress while the robot is in operation. Prepare a sufficiently rigid and stable installation base, taking into account the robot weight including the end effector (gripper) and workpiece.

**WARNING**

**IF THE INSTALLATION BASE IS NOT SUFFICIENTLY RIGID AND STABLE, VIBRATION (RESONANCE) MAY OCCUR DURING OPERATION, CAUSING ADVERSE EFFECTS ON THE ROBOT WORK.**

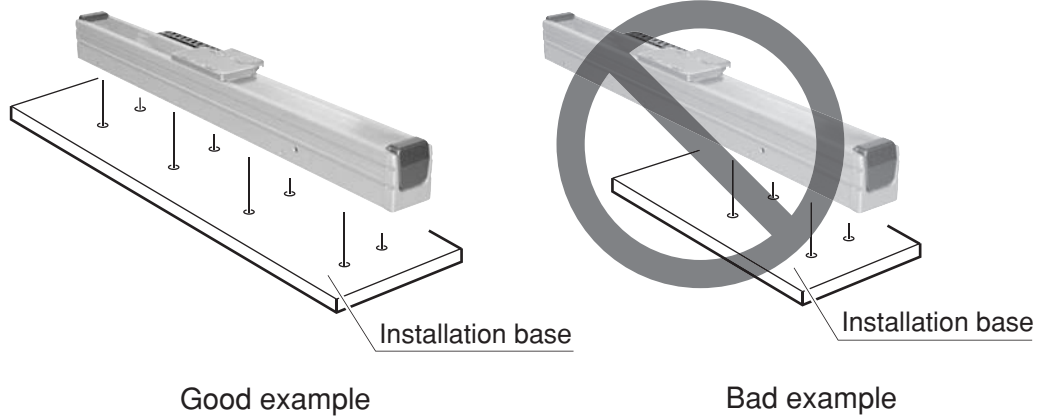
- 2) The installation base surface must be machined within a flatness of  $\pm 0.05\text{mm}/500\text{mm}$ .

**CAUTION**

**The robot positioning accuracy, acceleration and duty might not satisfy the required performance or the service life might be reduced if the installation surface precision is insufficient. In worst cases, the coil inside the robot might burn out.**

- 3) Use an installation base of sufficient size to match the robot body so that the robot can be installed with the specified number of bolts. Avoid installing the robot closer to one end as shown at the lower right.

#### Robot installation example



#### WARNING

WHEN INSTALLING THE ROBOT, ALWAYS USE ALL THE TAPPED HOLES ON THE BOTTOM OF THE ROBOT FRAME. USING LESS THAN THE SPECIFIED NUMBER OF BOLTS TO INSTALL THE ROBOT MAY CAUSE VIBRATION AND POOR POSITIONING ACCURACY. THIS MAY ALSO RESULT IN POSITIONING ERRORS AND REDUCED SERVICE LIFE IN THE WORST CASES.



#### NOTE

Refer to the external view and dimensions for each robot model shown in Chapter 7, "Specifications", for machining dimensions and positions of holes.

## 3-3 Installing the robot

To install the robot, drill holes through the installation base and secure the robot to the base with M4 bolts from the bottom. (M4 tapped holes are already machined on the bottom of the robot frame.)

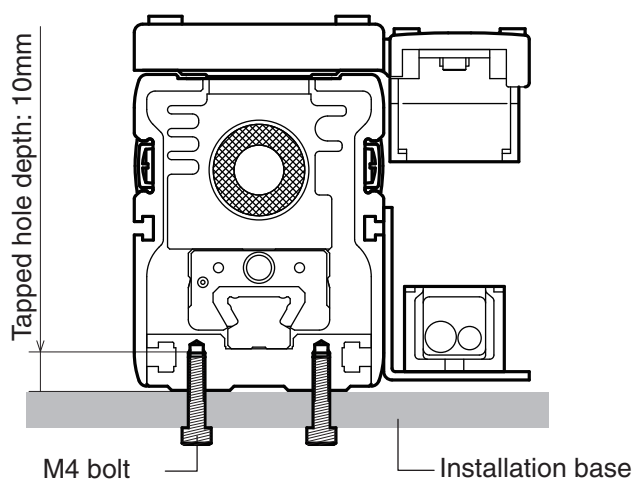


### WARNING

**BEFORE INSTALLING THE ROBOT, ALWAYS MAKE SURE THAT THE ROBOT CONTROLLER IS NOT CONNECTED TO THE ROBOT OR THE POWER TO THE CONTROLLER IS OFF. SERIOUS ACCIDENTS MIGHT OCCUR IF THE ROBOT STARTS TO OPERATE DURING INSTALLATION.**

After drilling the holes through the installation base where the robot is to be secured, secure the robot with the specified bolts from the bottom. The bolts and tightening torque are shown below.

	MR12/MR16/MR16H	MR20/MR25
Bolt	Hex socket-head M4 bolt, Strength: 8.8T Length: installation base thickness+9 <sup>+0</sup> <sub>-2</sub> mm	Hex socket-head M6 bolt, Strength: 8.8T Length: installation base thickness+10 <sup>+0</sup> <sub>-2</sub> mm
Tightening torque	30kgf•cm to 45kgf•cm	100kgf•cm to 130kgf•cm



### WARNING

**BE SURE TO USE THE BOLTS OF THE CORRECT LENGTH AND TIGHTEN THEM SECURELY TO THE CORRECT TORQUE. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE ROBOT VIBRATIONS, POSITION ERRORS AND SERIOUS ACCIDENTS.**

**WARNING**

BE SURE TO INSTALL THE ROBOT JUST AS LISTED IN THE PURCHASE SPECIFICATIONS (CABLE CARRIER DIRECTION AND INSTALLATION POSITION) ON THE ORDER FORM WE RECEIVED. INSTALLING THE ROBOT CONTRARY TO THOSE SPECIFICATIONS WILL CAUSE PROBLEMS SO USE CAUTION. IF INSTALLING THE ROBOT IN A DIRECTION OR POSITION DIFFERENT FROM THOSE IN THE PURCHASE SPECIFICATIONS, YOU MUST PLACE A SPECIAL ORDER. PLEASE CONSULT YAMAHA WHEN THIS IS NEEDED.

## 3-4 Installing an external leakage breaker and circuit protector

To ensure safety, a leakage breaker and circuit protector must be installed in the power supply connection section of the robot controller. Make correct connections by referring to the marks on the controller and the power supply connections shown below.



### WARNING

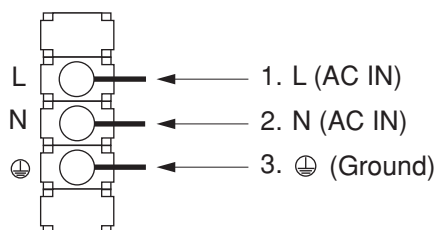
- ELECTRICAL SHOCKS, INJURIES OR FIRES MIGHT OCCUR IF THE MOTOR BREAKS DOWN WHILE THE ROBOT CONTROLLER IS USED WITHOUT INSTALLING A LEAKAGE BREAKER IN THE POWER SUPPLY SECTION.
- ELECTRICAL SHOCKS, INJURIES OR FIRES MIGHT OCCUR IF THE MOTOR BREAKS DOWN WHILE THE ROBOT CONTROLLER IS USED WITHOUT MAKING CORRECT CONNECTIONS TO THE POWER SUPPLY.  
USE A WIRE THICKER THAN 2.0 SQUARE MILLIMETERS.



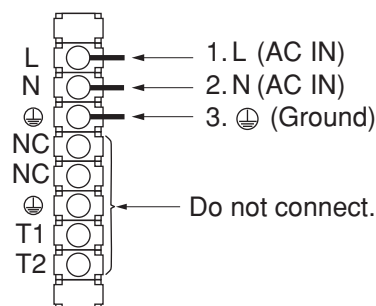
### CAUTION

Be careful not to make the wrong connections. Otherwise malfunctions may result.

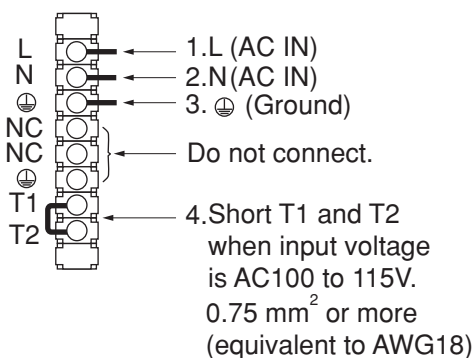
### 3-4-1 Power cable wiring for SRCP



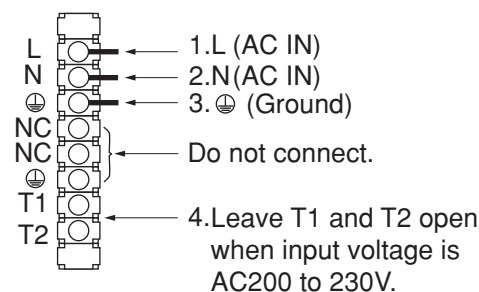
SRCP-05



SRCP-10, 20



AC 100V-115V



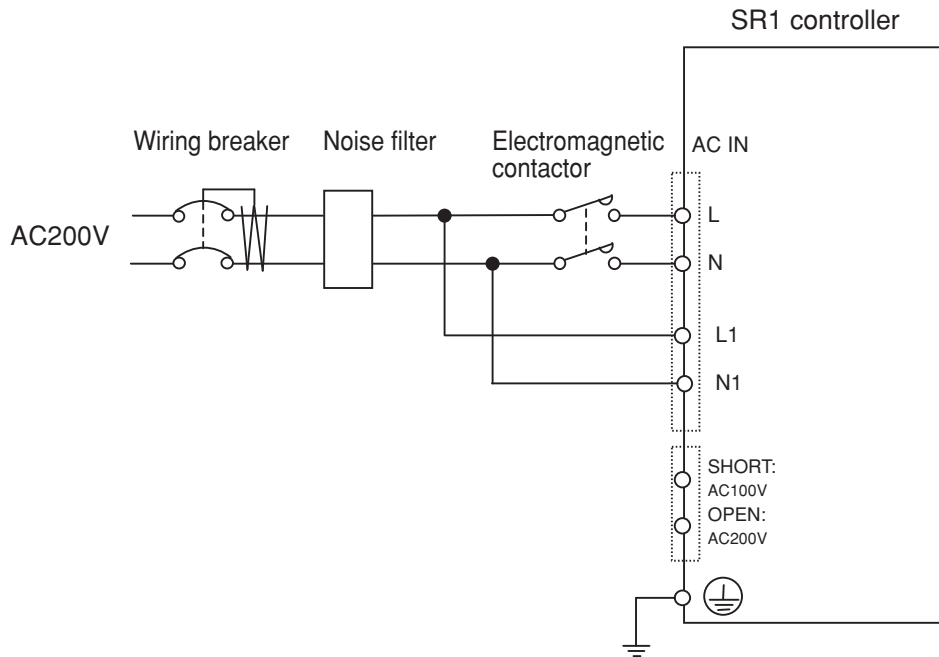
AC 200V-230V

SRCP-05A, SRCP-10A, SRCP-20A

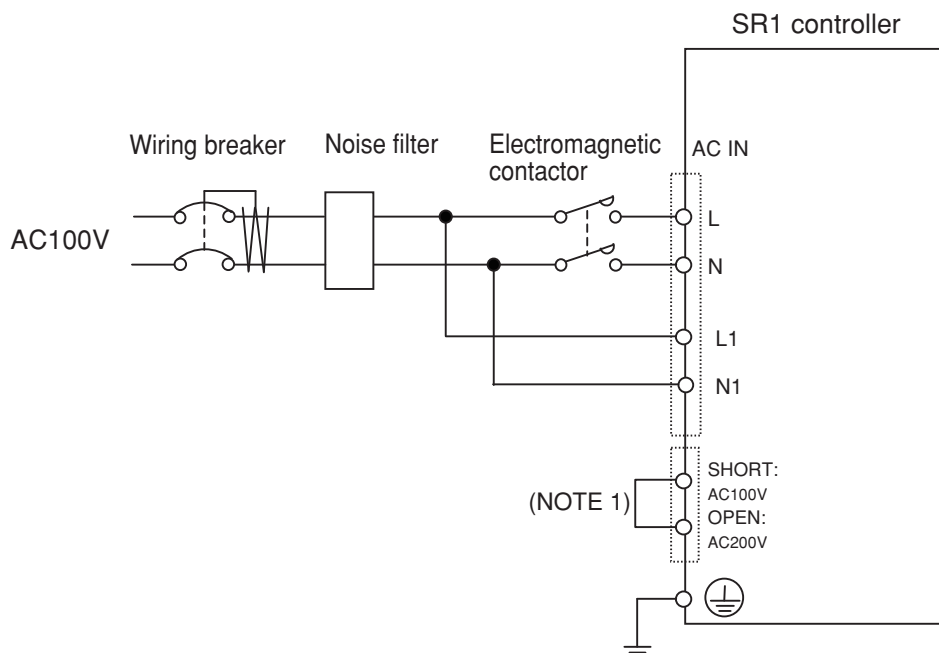


### 3-4-2 Power cable wiring for SR1

#### ■ AC 200V power supply voltage



#### ■ AC 100V power supply voltage

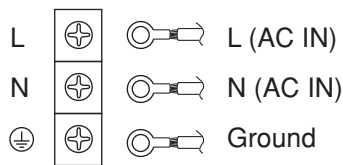


(NOTE) 1. The input voltage select terminals must be shorted when using AC 100V.

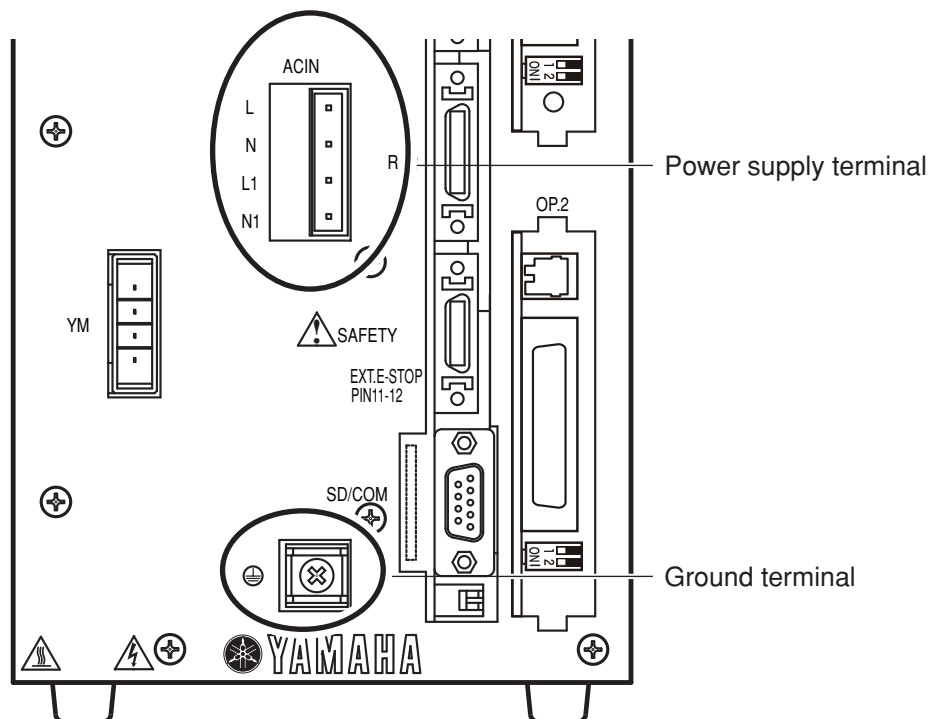
2. AC 100V power can be used only when the driver type is "-05" or "-10".

Terminal symbol	Name	Driver	Function
L, N	Main power input terminal	-05, -10	AC100 to 115 / 200 to 230V±10%, single phase, 50/60Hz
		-20	AC200 to 230V±10%, single phase, 50/60Hz
L1, N1	Control power input terminal	-05, -10	AC100 to 115 / 200 to 230V±10%, single phase, 50/60Hz
		-20	AC200 to 230V±10%, single phase, 50/60Hz
⏏	Ground terminal	-05, -10, -20	Connect to power supply terminal to provide proper grounding.


3-4-3 Power cable wiring for RCX141



3-4-4 Power cable wiring for RCX221



Symbol	Wiring		Remarks	
L	200 to 230V	Live	Main power supply (for motor power)	Wire cross-section 2.0 sq mm or more
N	200 to 230V	Neutral		
L1	200 to 230V	Live	Power for control	Wire cross-section 1.25 sq mm or more
N1	200 to 230V	Neutral		

	Ground	Class D grounding (100 ohms or less)	Tightening torque	1.4Nm
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## 3-5 Protective bonding



### WARNING

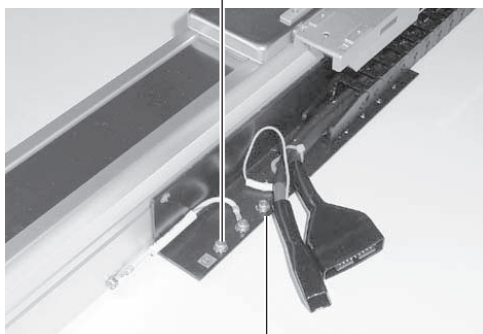
**ALWAYS GROUND THE ROBOT AND CONTROLLER UNIT TO PREVENT ELECTRICAL SHOCK.**

Always use the ground terminal (M4 screw) on the robot unit to make ground connection. The ground terminal location is shown below.

#### Ground terminal

##### 〈MR12〉

Ground terminal (M4 screw)  
for protective bonding



Ground terminal (M4 screw)  
for robot cable

##### 〈MR16/MR16H〉

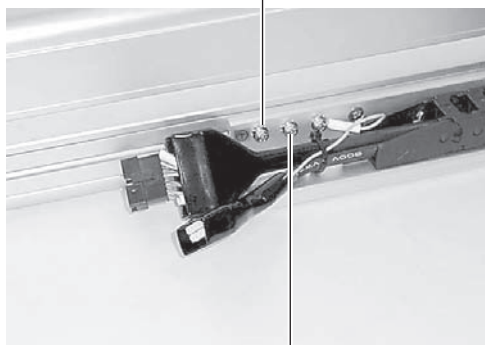
Ground terminal (M4 screw)  
for protective bonding



Ground terminal (M4 screw)  
for robot cable

##### 〈MR20/MR25〉

Ground terminal (M4 screw)  
for protective bonding



Ground terminal (M4 screw)  
for protective bonding



### CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm<sup>2</sup>) as the ground wire.

**WARNING**

**BEFORE MAKING THE GROUND CONNECTION, MAKE SURE THAT THE CONTROLLER IS NOT CONNECTED TO THE ROBOT OR THE POWER TO THE CONTROLLER IS OFF.**

Provide a terminal marked "PE" as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.



(Symbol 417-IEC5019)

## 3-6 Connecting the robot to the controller

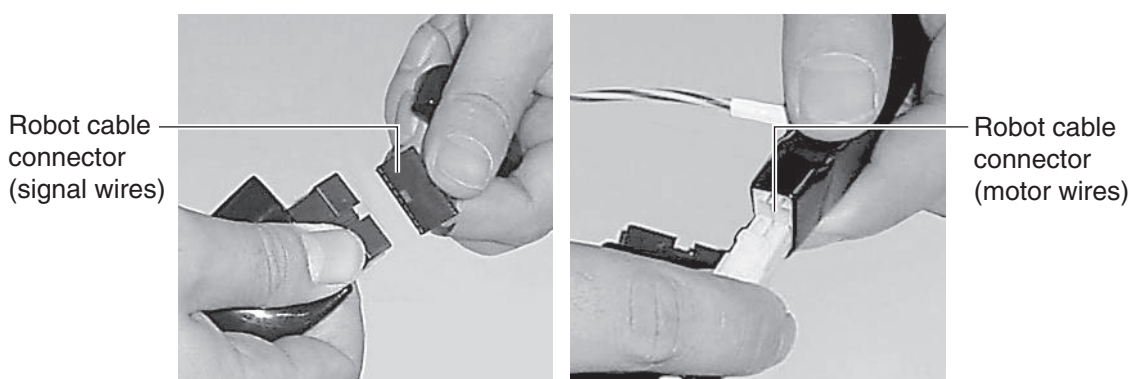
Connect the robot cables to the mating connectors on the controller as instructed below. Refer to the robot controller user's manual for the connectors on the controller.



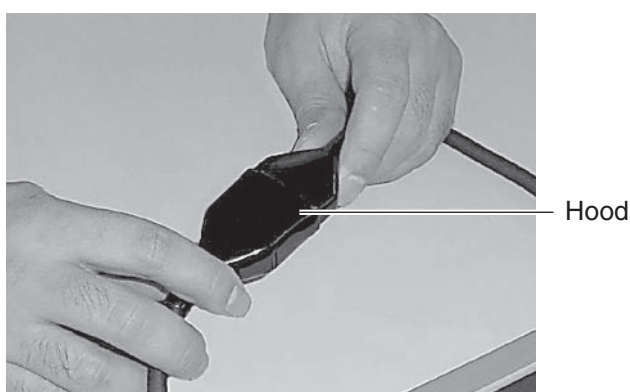
### WARNING

- BEFORE CONNECTING THE CABLES, CHECK THAT THERE ARE NO BENDS OR BREAKS IN THE ROBOT CABLE CONNECTOR PINS AND THAT THE CABLES ARE NOT DAMAGED. BENT OR BROKEN PINS OR CABLE DAMAGE MAY CAUSE ROBOT MALFUNCTIONS.
- ALWAYS MAKE SURE THAT THE POWER TO THE ROBOT CONTROLLER IS OFF BEFORE CONNECTING THE CABLES OR GROUND WIRES.

1) Connect the robot cables (motor and I/O signal wires) to the mating connectors coming out from the robot.



2) After making the connections, fit the connector hoods together securely.

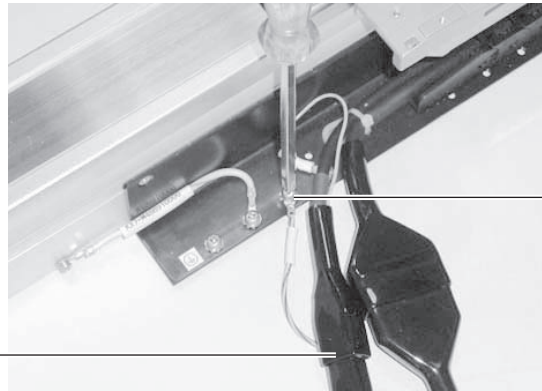


### CAUTION

After making the connections, fit the connector hoods together securely.

3) Connect the robot cable ground terminal to the ground terminal on the robot frame.

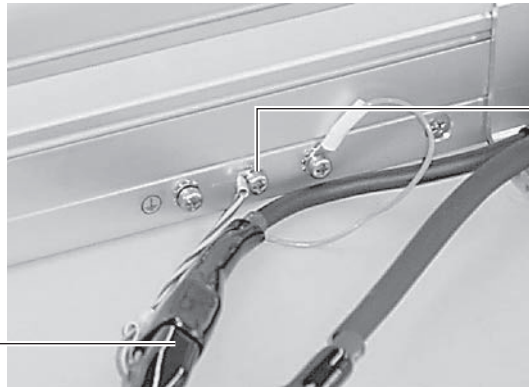
### 〈MR12〉



Connect to this ground terminal.

Robot cable connector (motor wires)

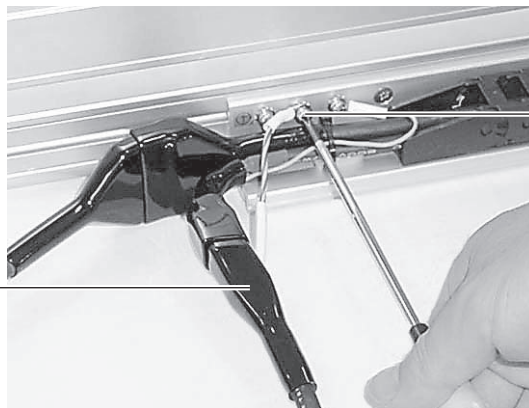
### 〈MR16/MR16H〉



Connect to this ground terminal.

Robot cable connector (motor wires)

### 〈MR20/MR25〉



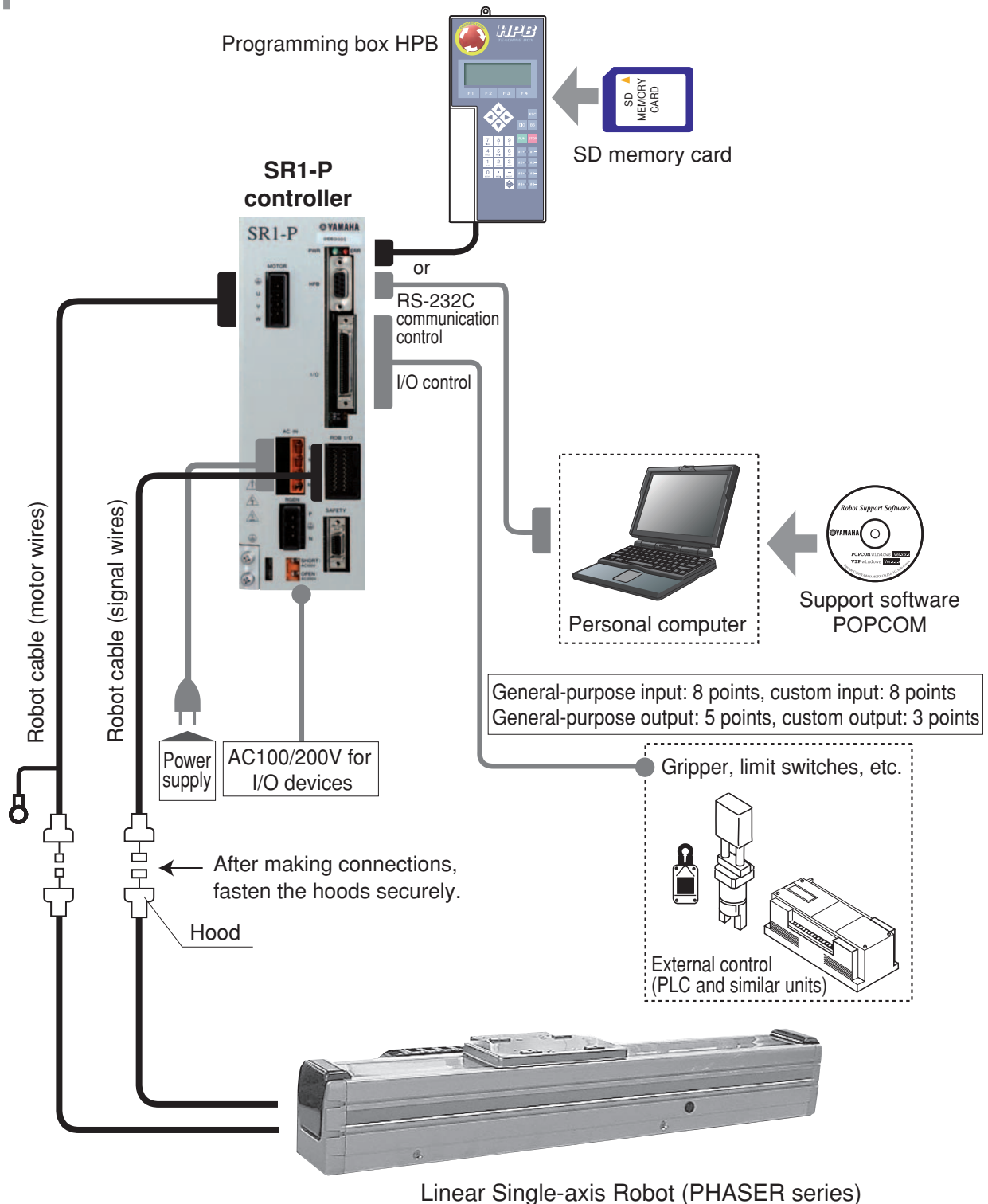
Connect to this ground terminal.

Robot cable connector (motor wires)

### Robot cable connections

Refer to "7-4 Robot cable (I/O signal wires)" and "7-5 Robot cable (motor wires)" when wiring the cables.

#### Robot cable connections



\* Programming box HPB and support software POPCOM are sold

## 3-7 Precautions during user wiring and hose installation

### ● Cable carries (plastic chain for cable guide)

The PHASER series has cable carriers available as options used to manage user cables and air hoses as they move. Always observe the following precautions when using these optional cable carriers.



#### CAUTION

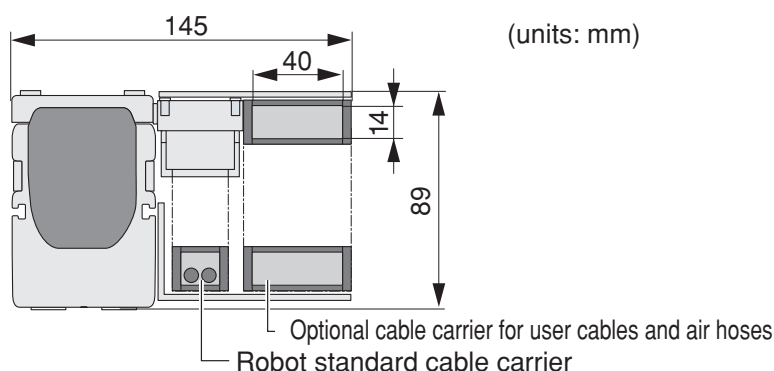
- The cable and air hoses should take up less than 30% of the space when storing them inside the cable carrier. Lay out the cables and air hoses in rows inside the cable carrier so they do not cross each other.
- The cables and air hoses inside the cable carrier will shift while the robot is operating, becoming taut and placing a strain on the connectors at both ends. To prevent this loosely fasten the cables and air hose to the cable carrier with cable ties to prevent strain from being applied. (Fasten them lightly since the cables and hoses might break if secured too tightly.)
- Do not remove or mount brackets installed on the cable carrier or attempt to modify them.
- The user should not install cables or hoses in the robot standard cable carrier.

Optional cable carriers for user cables and air hoses consist of a wide M type and a narrow S type. Install them by using the brackets as shown in the drawing below.

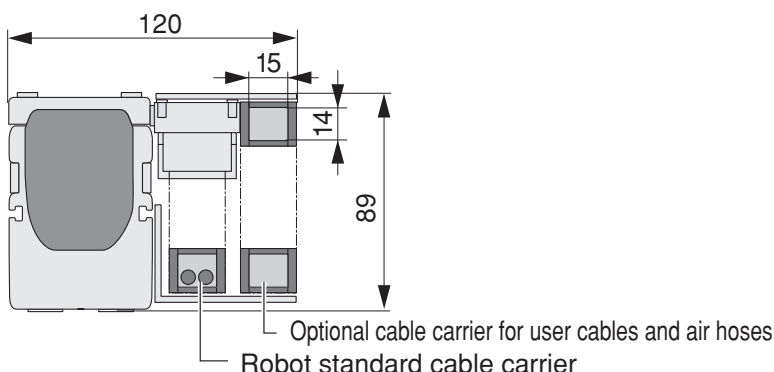
#### Optional cable carrier for user cables and air hoses (horizontal installation)

〈MR12〉

##### ● M type



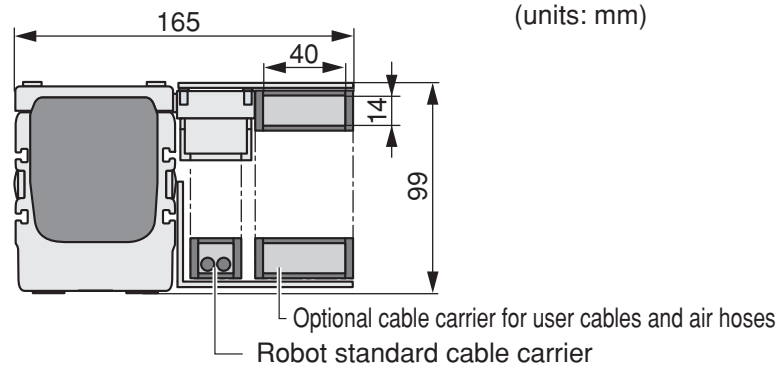
##### ● S type



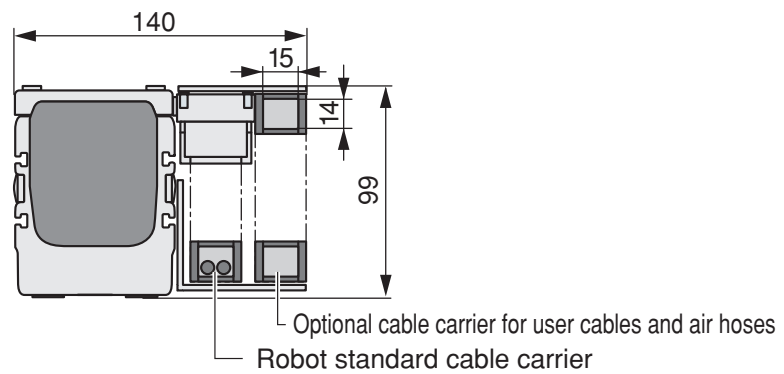


## 〈MR16/MR16H〉

### ● M type

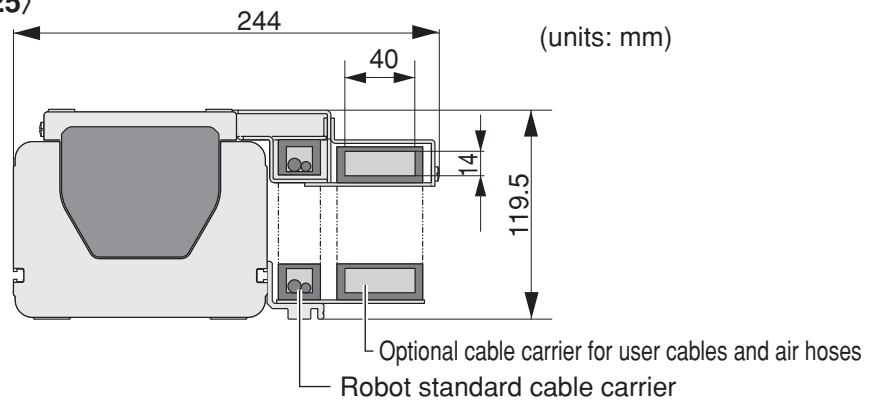


### ● S type

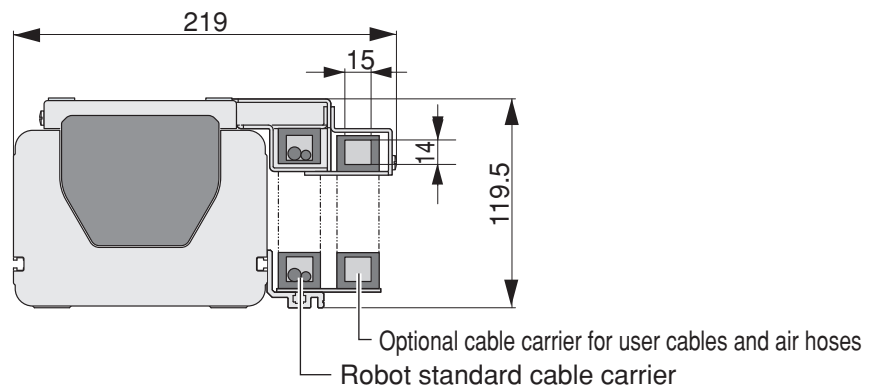


## 〈MR20/MR25〉

### ● M type



### ● S type



## MEMO

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## 4-1 Notes on robot operation

On the PHASER series MR type robots, two linear scale specifications are provided: incremental specification and semi-absolute specification. Action after power-on differs depending on the linear scale specifications. Keep the following points in mind.

### 4-1-1 Magnetic pole estimation action

- When starting the PHASER series robots, the slider always moves a few millimeters right after the servo is turned on and emits a high pitched noise. This is just the routine pre-action for estimating the magnetic pole and is not a problem.
- Do not apply any external force or impact on the robot during the magnetic pole estimation action. Doing so may cause a failure in the magnetic pole estimation action.
- Both in the incremental and semi-absolute specifications, the magnetic pole estimation action is performed at servo-on immediately after turning the power on.

### 4-1-2 Absolute search (semi-absolute specification)

On the semi-absolute specification, absolute search (absolute position detection) must be performed after turning power on before starting operation. Current position is found by reading the signal recorded on the linear scale during absolute search. The slider (carriage) moves a maximum of 76mm while reading the signal. (The distance that the slider moves can be shortened by allowing the slider to move back and force for signal read.

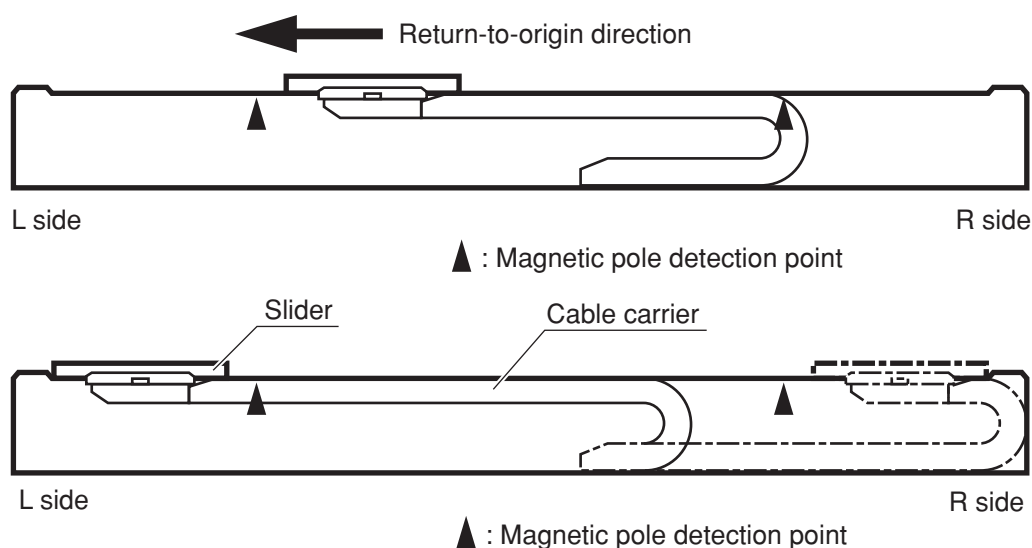
#### ■ Absolute search motion

- Absolute reset speed is set to 20 (mm per second) prior to shipment. This speed can be reduced by parameter entry.
- Absolute search sequence: When an absolute search (return-to-origin) command is input or the HPB is used to perform absolute search, the slider moves in the direction specified by parameter and then stops when the origin position is found, allowing automatic operation.

### 4-1-3 Return to origin (incremental specification)

#### ■ Origin position

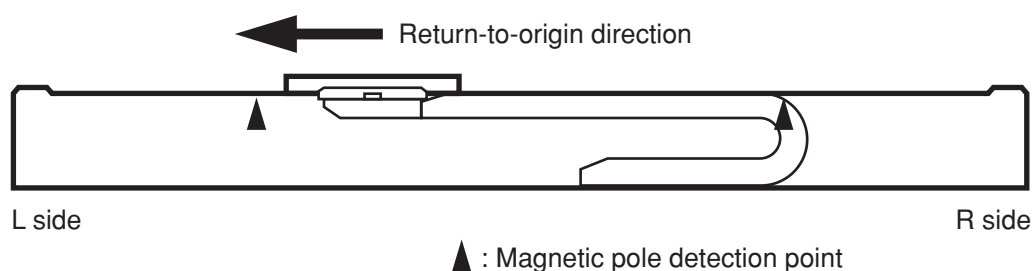
- On the incremental specification, return-to-origin must be performed after turning power on before starting operation. Magnetic poles are also detected during return-to-origin. Once return-to-origin is completed, there is no need to perform it again unless the controller power is turned off or an error occurs.
- There are two positions at which the origin can be set. These are located one each on both ends of the stroke. Refer to the outline dimension drawings shown in Chapter 7, "Specifications". Unless specified otherwise, the origin position is set on the L side prior to shipment. The origin position can be set on the R side by changing the parameter. (See the separate "SR1 Controller User's Manual" for information on changing the parameter.)



#### ■ Return-to-origin operation

- Return-to-origin speed is set at 20 (mm per second) prior to shipment. This speed can be changed in increments of 1 to 100 (mm per second) by parameter entry.
- Return-to-origin sequence: Robot moves as follows by entering a return-to-origin command or a return-to-origin operation from the HPB.

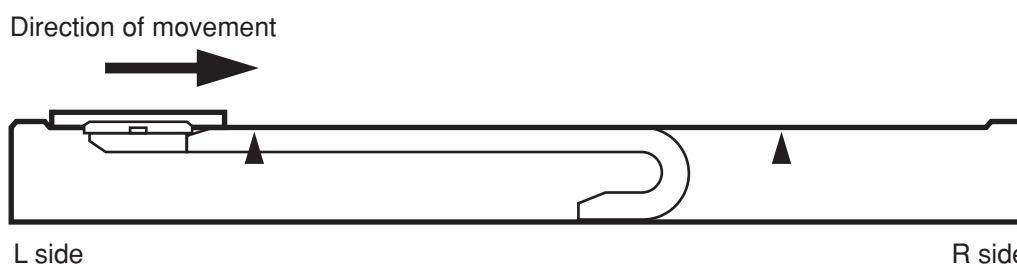
- (1) Slider moves in the specified return-to-origin direction at a speed set by the parameter.



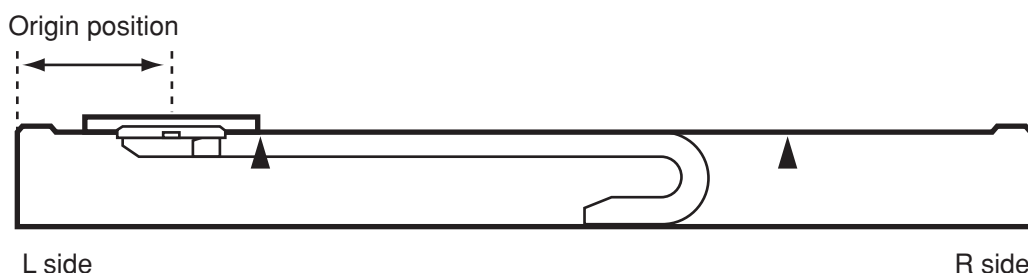
- (2) Slider moves in reverse direction after contacting the mechanical stopper (stroke end detected).

**CAUTION**

If the magnetic pole was not detected in the operation above in (1), in other words, if return-to-origin started from a position on the left of the magnetic pole detection point (▲), then the slider returns to the magnetic pole detection point (▲). There, the slider moves in the reverse direction and re-performs the operation in (1). (This is not an equipment problem.)



- (3) Slider (carriage) moves from the stroke end to the origin position and then stops to complete return-to-origin. Refer to the outline dimension drawings shown in Chapter 7, "Specifications".

**Reference**

See the separate "SR1 Controller User's Manual" for more information on return-to-origin operation.

## 4-2 Setting operating conditions

You must set operating parameters such as the payload, speed and acceleration in order to obtain maximum performance from the PHASER series robot.

### 4-2-1 Process flow for setting operating conditions

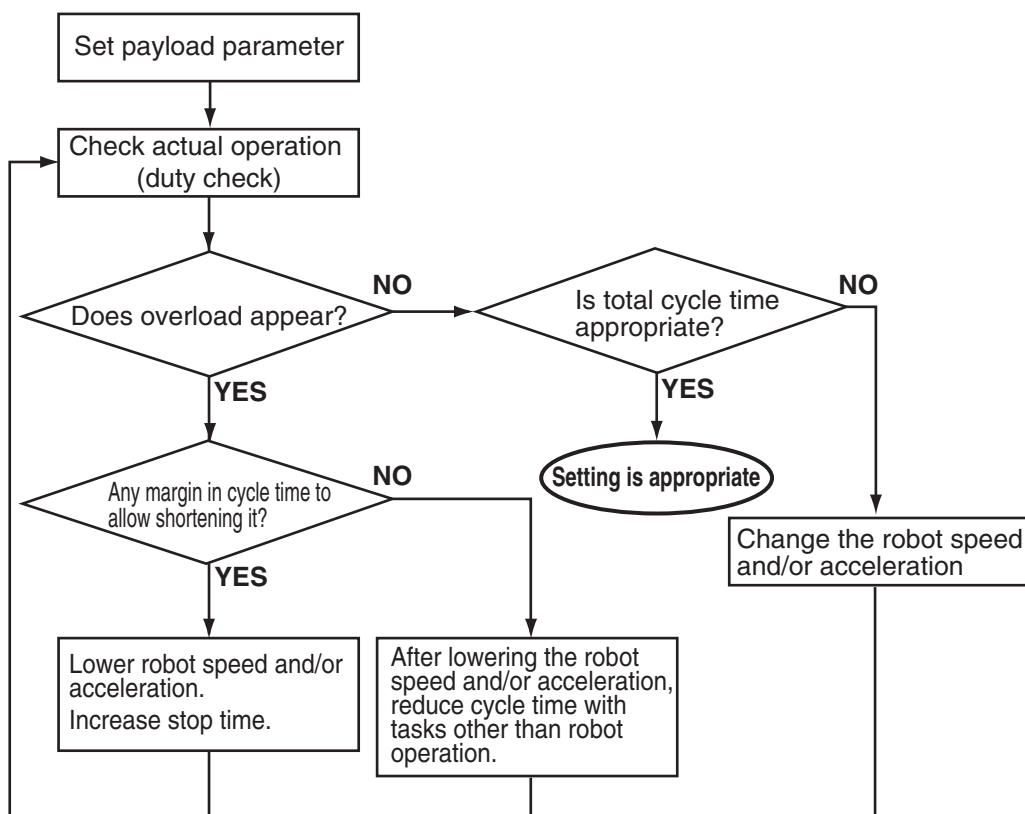
Set optimum parameters using the flow chart below as a reference.



Reference

See the separate "SR1 Controller User's Manual" for more information on setting parameters.

#### Process flow for setting operating conditions





## 4-2-2 Duty monitor

An overload error appears to warn the motor is working too hard during tough robot operation. In these cases, either the robot acceleration or maximum speed must be lowered, or the robot stop time increased (lower the duty). On the other hand, if you want to shorten the cycle time even further, when there is currently no overload, you can raise the acceleration or maximum speed, or shorten the robot stop time (raise the duty). Viewing the duty monitor allows you to easily check the current robot operating status to find out how hard the robot can still work versus overload criteria. By checking the duty monitor, you can repeatedly change the settings and view the available duty to obtain ideal operating conditions.

### ● How to monitor the operation duty

To monitor the operation duty using the programming box (HPB), follow these steps.

- 1) Connect the HPB to the SR1 controller and turn on the controller power.  
The initial menu then appears on the HPB.

- 2) Press **F4** (MON) on the initial menu to enter MONITOR mode.

- 3) Press **F2** (DUTY).

- 4) Press **F1** (RUN) to start measuring the operation duty.

- 5) Press the **F2** (STOP) key to quit measurement.  
Pressing the **F2** (STOP) key retains the measurement data.

```
[MENU]
select menu
1EDIT 2OPRT 3SYS 4MON
```

```
[MON]
select menu
1DIO 2DUTY
```

```
[MON-DUTY]
select menu
measuring ...
1RUN 2STOP 3RSLT
```

- 6) Press the **[F3]** (RSLT) key to display the measurement data.

The operation duty value in the period from pressing **[F1]** (RUN) up to pressing the **[F2]** (STOP) then appears as a percentage.

```
[MON-DUTY]
measurement data
X = 50%
```



#### Reference

The operation duty can also be monitored while the program is running by using a program command. See the "SR1 Controller User's Manual" for more information.

## 4

### 4-2-3 Maximum speed setting

The initial maximum speed setting for standard PHASER series robots is 2000 mm/sec, although they are capable of operating at up to 2500 mm/sec.

As the robot speed increases, the effective current value becomes large so the duty needs to be reduced. It will be most effective to use the robot at 2000 mm/sec in normal operation and at 2500mm/sec only when the robot moves a long distance. (The maximum speed might not be obtained depending on the operating conditions.)

#### ● Changing the maximum speed setting

To change the maximum speed setting by using the programming box (HPB), follow these steps.

- 1) Connect the HPB to the SR1 controller and turn on the controller power.  
The initial menu then appears on the HPB.

- 2) Press **[F3]** (SYS) on the initial menu to enter SYSTEM mode.

```
[MENU]
select menu
1EDIT 2OPRT 3SYS 4MON
```



- 3) Press **[F1]** (PRM).  
The parameter setting mode is entered.

```
[SYS]
select menu
1PRM 2B. UP 3INIT 4next
```


- 4) Select the parameter group.  
Press **[F1]** (AXIS) to select the axis parameters.

```
[SYS-PRM]
select menu
1AXIS 2DATA 3SYS1 4SYS2
```

The current setting for PRM100 (robot type) appears on the screen.

Press the   keys to scroll up or down the parameters until PRM129 (Max. speed) is displayed.

[	S	Y	S	-	P	R	M	-	A	X	I	S	]						
P	R	M	1	0	0	=				4	2	1	5						
r	o	b	o	t		t	y	p	e										
r	e	a	d			o	n	l	y										

- 5) When PRM129 (Max. speed) is displayed, use the number keys to enter the maximum speed 2500 (mm/sec) and press .

This parameter setting changes the 100% operation speed to 2500mm/sec from 2000mm/sec. (After this change, the 80% of the operation speed equals 2000mm/sec.)

[	S	Y	S	-	P	R	M	-	A	X	I	S	]					
P	R	M	1	2	9	=				2	5	0	0					
M	a	x	.			s	p	e	e	d								
r	a	n	g	e			1	→		2	5	0	0					

- 6) The cursor returns to the top of data when the parameter has been set correctly.

[	S	Y	S	-	P	R	M	-	A	X	I	S	]					
P	R	M	1	2	9	=				2	5	0	0					
M	a	x	.			s	p	e	e	d								
r	a	n	g	e			1	→		2	5	0	0					

### 4-2-4 Acceleration setting

Optimal acceleration for the PHASER series robots is automatically set by entering the payload parameter value. In the payload parameter, set the total weight of the workpiece and the end effectors such as hands or grippers attached to the robot slider. (Acceleration can also be changed by parameter.)



#### CAUTION

**Be sure to enter an accurate value when making this setting, since a mistake will cause troubles such as vibration or a shorter service life span.**

#### ● Setting the payload parameter

To set the payload parameter by using the programming box (HPB), follow these steps.



- 1) Connect the HPB to the SR1 controller and turn on the controller power.  
The initial menu then appears on the HPB.


- 2) Press **F3** (SYS) on the initial menu to enter SYSTEM mode.

- 3) Press **F1** (PRM).  
The parameter setting mode is entered.

- 4) Select the parameter group.  
Press **F1** (AXIS) to select the axis parameters.

The current setting for PRM100 (robot type) appears on the screen.

Press the   keys to scroll up or down the parameters until PRM112 (payload) is displayed.

- 5) When PRM112 (payload) is displayed, use the number keys to enter the payload and press .
- 6) The cursor returns to the top of data when the parameter has been set correctly.

```
[MENU]
select menu
1EDIT 2OPRT 3SYS 4MON
```

```
[SYS]
select menu
1PRM 2B. UP 3INIT 4next
```

```
[SYS-PRM]
select menu
1AXIS 2DATA 3SYS1 4SYS2
```

```
[SYS-PRM-AXIS]
PRM100 = _4215
robot type
read only
```

```
[SYS-PRM-AXIS]
PRM112 = 10_ [kg]
payload
range 0→MAX
```

```
[SYS-PRM-AXIS]
PRM112 = _10 [kg]
payload
range 0→MAX
```

## 4-3 Pulse train control (SRCP)

When you control the robot movement by pulse train input, read the following description and comply with the precautions. For detailed information on pulse train control and specifications, refer to the separate "SRCP controller: Pulse train mode" supplementary manual.

### 4-3-1 Acceleration/Deceleration and position proportional gain

- **Acceleration/Deceleration waveforms**

Use sinusoidal acceleration/deceleration to issue acceleration/deceleration instructions. Using other waveforms might adversely affect positioning accuracy and current value stability.

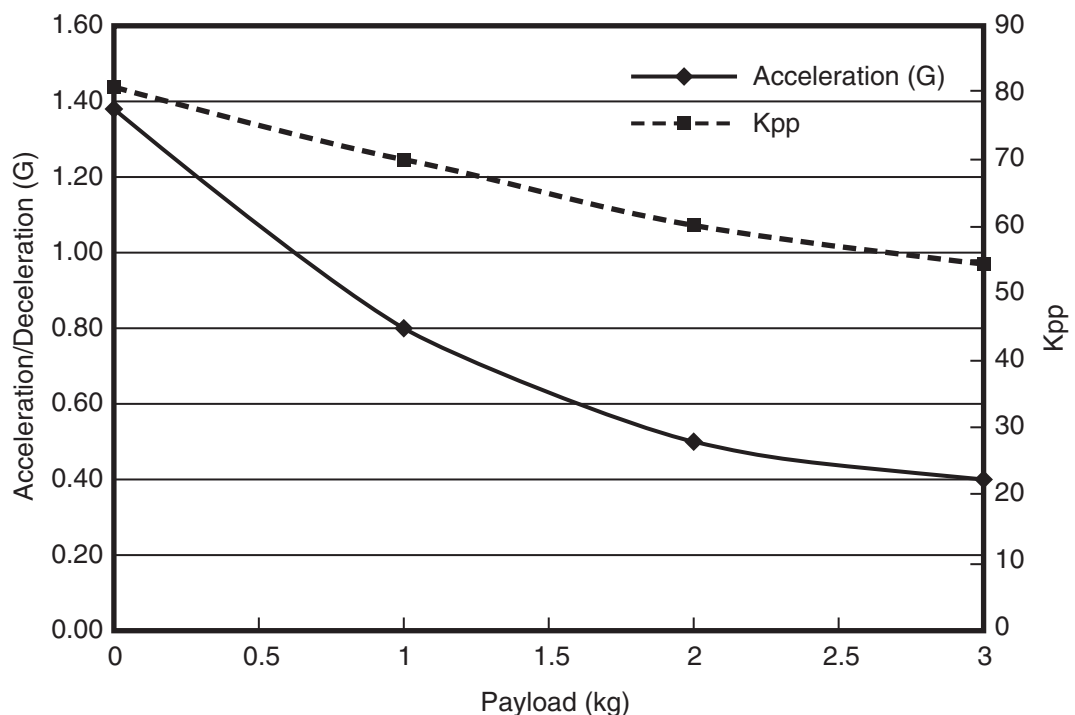
- **Acceleration/Deceleration and position proportional gain**

Acceleration/Deceleration and position proportional gain at different payloads are shown in the tables and graphs below. Select the desired parameter values by referring to these tables and graphs.

MR12

Payload (kg)	Average acceleration/deceleration (G)	Peak value during sinusoidal acceleration/deceleration (G)	Kpp (PRM19)
0	1.38	2.17	80
1	0.80	1.26	70
2	0.50	0.79	60
3	0.40	0.63	55

Note: Acceleration/Deceleration values apply to linear acceleration/deceleration.

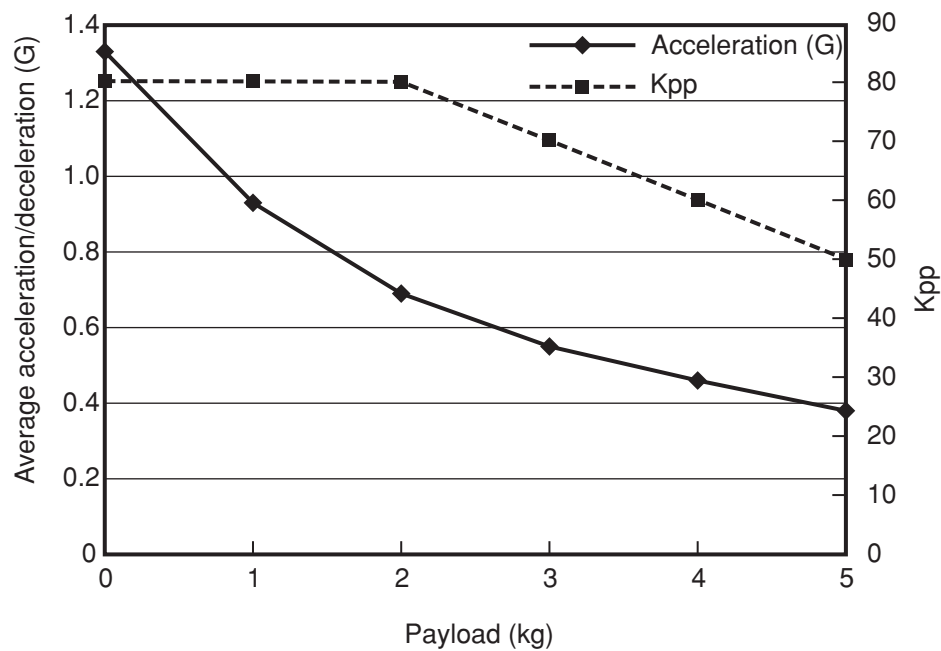


## MR16/MR16H

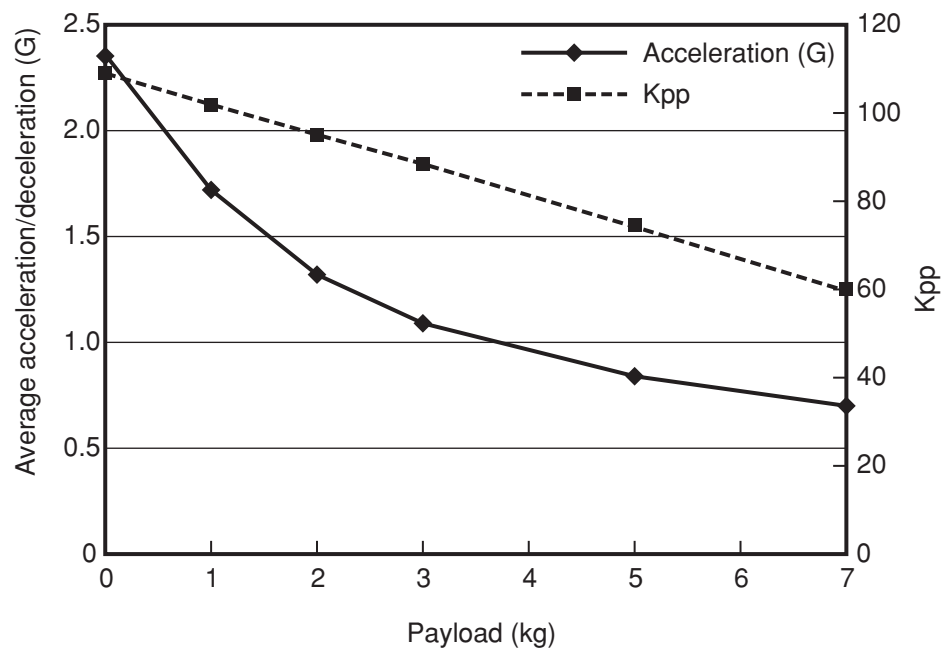
Payload (kg)	Average acceleration/deceleration (G)		Peak value during sinusoidal acceleration/deceleration (G)		Position proportional gain (PRM19)	
	MR16	MR16H	MR16	MR16H	MR16	MR16H
0	1.33	2.36	2.10	3.00	80	109
1	0.93	1.72	1.47	2.71	80	102
2	0.69	1.32	1.08	2.07	80	95
3	0.55	1.09	0.87	1.72	70	88
4	0.46	—	0.72	—	60	—
5	0.38	0.84	0.60	1.33	50	74
7	—	0.70	—	1.10	—	60

Note: Acceleration/Deceleration values apply to linear acceleration/deceleration.

## ● MR16



## ● MR16H

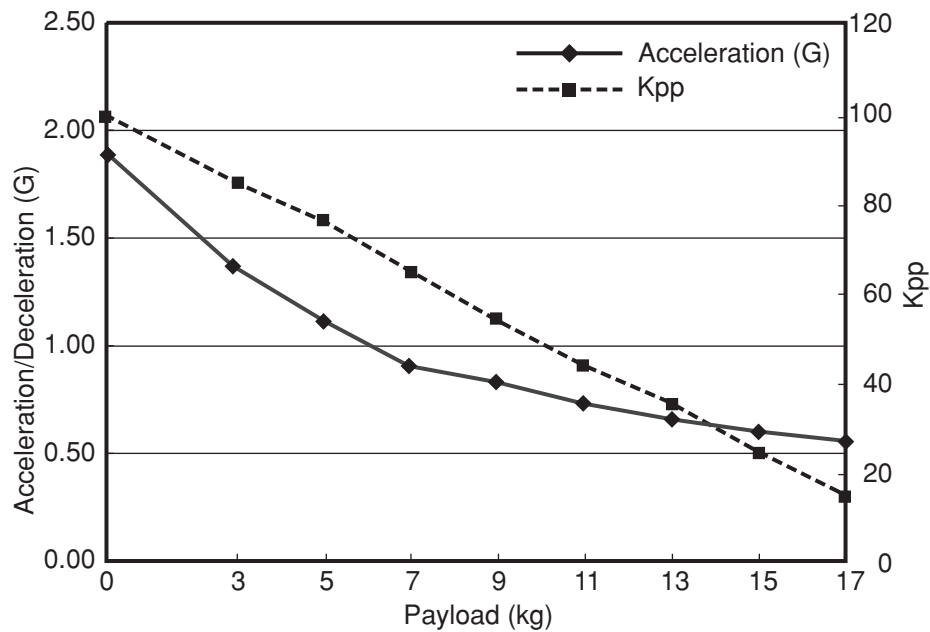


## MR20/MR25

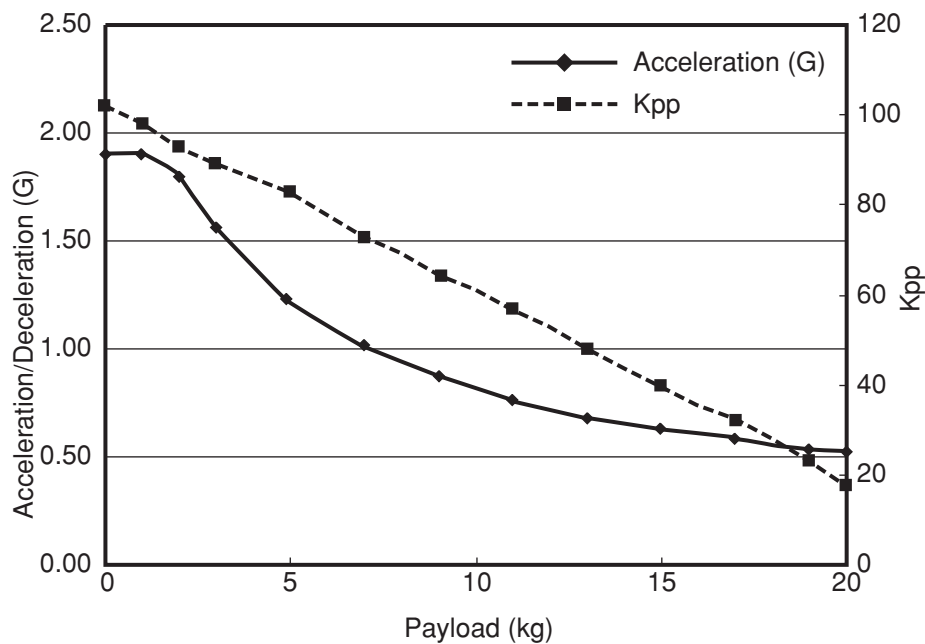
Payload (kg)	Acceleration/Deceleration (G)		Peak value during sinusoidal acceleration/deceleration (G)		Position proportional gain Kpp (PRM19)	
	MR20	MR25	MR20	MR25	MR20	MR25
0	1.91	1.91	3.00	3.00	100	102
1	1.84	1.91	2.89	3.00	95	98
2	1.60	1.80	2.51	2.83	90	94
3	1.39	1.56	2.18	2.45	85	90
5	1.09	1.23	1.71	1.93	75	82
7	0.90	1.02	1.41	1.60	65	73
9	0.83	0.87	1.30	1.37	55	65
11	0.74	0.76	1.16	1.19	45	57
13	0.67	0.68	1.05	1.07	35	48
15	0.60	0.62	0.94	0.97	25	40
17	0.54	0.57	0.85	0.90	15	32
19	—	0.53	—	0.83	—	23
20	—	0.51	—	0.80	—	19

Note: Acceleration/Deceleration values apply to linear acceleration/deceleration.

## ● MR20



## ● MR25

**CAUTION**

If the acceleration is too high, the robot might not follow the instructions or overloads occur.

**Reference**

The Position proportional gain parameter (PRM19) is a hidden parameter. For detailed information on how to display and change hidden parameters, see the "SRCP Series Controller User's Manual".



### 4-3-2 Setting the maximum speed

In the case of pulse train control, the robot moves 1 micrometer per pulse.

To operate the robot at a maximum speed (2500 mm/sec), a pulse train at 2.5Mpps must be input. (The maximum speed might not be obtained depending on the operating conditions.)

As the speed increases, the sliding resistance also increases and overloads tend to occur. We recommend you first check the robot operation at 2000 mm/sec (2Mpps input).

## MEMO

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## 5-1 Before beginning work

Periodic inspection and maintenance are essential to ensure safe and efficient operation of YAMAHA robots. This chapter describes periodic inspection items and procedures for the PHASER series. Before beginning work, read the precautions below and also in Chapter 1 "Using the Robot Safely" and follow the instructions.



### DANGER

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IF THE INSPECTION OR MAINTENANCE PROCEDURE CALLS FOR OPERATION OF THE ROBOT, STAY OUT OF THE WORKING AREA OF THE ROBOT DURING OPERATION. DO NOT TOUCH ANY PARTS INSIDE THE CONTROLLER. KEEP WATCHING THE ROBOT MOVEMENT AND SURROUNDING AREA SO THAT THE OPERATOR CAN PRESS THE EMERGENCY STOP BUTTON IF ANY DANGER OCCURS.

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### WARNING

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- WHEN THE ROBOT DOES NOT NEED TO BE OPERATED DURING ADJUSTMENT OR MAINTENANCE, ALWAYS TURN OFF THE CONTROLLER AND THE EXTERNAL SWITCH BOARD.
  - DO NOT TOUCH INTERNAL PARTS OF THE CONTROLLER FOR 10 MINUTES AFTER THE CONTROLLER HAS BEEN TURNED OFF.
  - WHEN ONLY MAKING ELECTRICAL INSPECTIONS AND REQUIRING NO MECHANICAL MOVEMENT OF THE ROBOT, KEEP THE EMERGENCY STOP BUTTON PRESSED.
  - USE ONLY LUBRICANT AND GREASES SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE.
  - USE ONLY PARTS SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE. TAKE SUFFICIENT CARE NOT TO ALLOW ANY FOREIGN MATTER TO CONTAMINATE THEM DURING ADJUSTMENT, PARTS REPLACEMENT OR REASSEMBLY.
  - DO NOT MODIFY ANY PARTS ON THE ROBOT OR CONTROLLER. MODIFICATION MAY RESULT IN UNSATISFACTORY SPECIFICATIONS OR THREATEN OPERATOR SAFETY.
  - WHEN ADJUSTMENT OR MAINTENANCE IS COMPLETE, RETIGHTEN THE BOLTS AND SCREWS SECURELY.
  - DURING ROBOT ADJUSTMENT OR MAINTENANCE, PLACE A SIGN INDICATING THAT THE ROBOT IS BEING ADJUSTED OR SERVICED TO PREVENT OTHERS FROM TOUCHING THE CONTROL KEYS OR SWITCHES. PROVIDE A LOCK ON THE SWITCH KEYS OR ASK SOME ONE TO KEEP WATCH AS NEEDED.
- 
-

**WARNING**

DO NOT DISASSEMBLE THE ROBOT. THE INTERNAL MAGNETIC SHAFT CONTAINS POWERFUL PERMANENT MAGNETS SO DISASSEMBLY WITHOUT PROPER PREPARATION IS HAZARDOUS. ATTEMPTING TO DISASSEMBLE IT MIGHT ALSO PREVENT OBTAINING THE SPECIFIED PERFORMANCE.

When applying grease to the internal linear guide, take the following precautions.

**WARNING****PRECAUTIONS WHEN HANDLING GREASE:**

- INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES.  
BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.
- INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.
- DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)
- HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE GREASE CONTAINER, SO USE PROTECTIVE GLOVES.
- KEEP OUT OF THE REACH OF CHILDREN.
- DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.

**EMERGENCY TREATMENT:**

- IF GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.
- IF GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.
- IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR PROPER TREATMENT.

## 5-2 Periodic inspection

The PHASER series robots use a linear motor and a linear guide with ball retainer, and require little user maintenance. However, perform the following daily and periodic inspections.

### 5-2-1 Daily inspection

Check the following points on a daily basis, before and after robot operation.

Checkpoints	Check items	Notes
Cables and connectors	Check for scratches, damages and excessively tight bends.	Consult us if damages or abnormal conditions are found.
Shutter	Check scratches and dents.	
Motor	Check for unusual vibration and noise, and for abnormal temperature rise.	



#### Reference

When starting the PHASER series robots, the slider always moves a few millimeters right after the servo is turned on and emits a high pitched noise. This is just the routine pre-action for finding the magnet pole and is not a problem.

### 5-2-2 Six-month inspection

Check the following points every 6 months and apply grease if needed.

Checkpoints	Check items	Notes
Shutter	Check for slack. Adjust if necessary.	See "5-4" in this chapter.
Linear guide	When the robot is operated 16 hours a day, lubricate with the recommended grease. Standard robots: <MR16/16H>    Alvania No. 2 (Shell) Daphne Eponex No. 2 (Idemitsu) <MR12/20/25>   AFA (THK) Clean room robots: <MR16/16H>    LG-2 (NSK) <MR12/20/25>   AFF (THK)	See "5-3" in this chapter.



#### CAUTION

Using grease other than those recommended by YAMAHA might shorten the service life of the linear guide.

### 5-2-3 Annual inspection

Inspect the following points once every year and make adjustments or perform maintenance if needed.

Checkpoints	Check items	Notes
Shutter	Check for slack. Adjust if necessary.	See "5-4" in this chapter.
Bolts and screws on robot	Check for looseness. If loose, tighten.	
Robot installation bolts	Check for looseness. If loose, tighten.	
Linear guide	Check for vibration during operation.	Contact us if vibration or abnormality occurs.
Lubrication of linear guide	Apply the recommended grease to the linear guide.	See "5-3" in this chapter.



## 5-3 Greasing to the linear guides

When applying grease to the linear guides of the robot according to periodic inspection, follow the procedure below.



### WARNING

- ENSURE ADEQUATE SAFETY IN THE WORK AREA BEFORE STARTING WORK.
- ALWAYS TURN OFF THE CONTROLLER POWER BEFORE STARTING WORK.
- POWERFUL MAGNETS ARE INSTALLED INSIDE THE ROBOT. THERE IS A RISK OF INJURY DUE TO MAGNETIC ATTRACTION. TAKE EXTRA CAUTION.
- DEVICES SUCH AS CARDIAC PACEMAKERS THAT MAY MALFUNCTION DUE TO MAGNETIC FIELDS MUST BE KEPT AWAY FROM THE ROBOT.

### 5-3-1 MR12

When applying grease to the MR12, remove the end covers of the robot unit and use the grease nipple located inside each end cover. Before starting, prepare the specified grease (See 5-2) and grease gun.

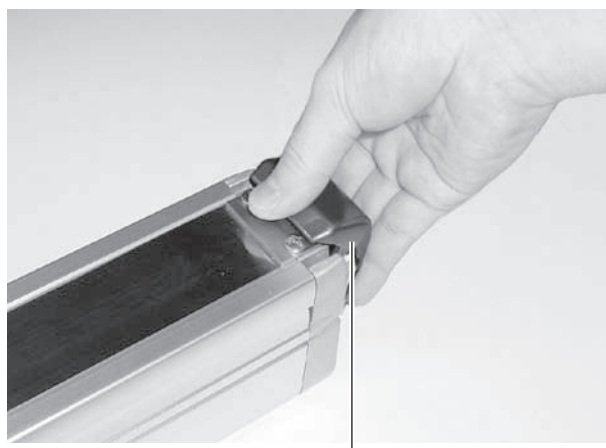
Recommended grease : AFA (THK)

Recommended grease gun : MG70 (THK) with N-type nozzle

1) Check that the controller power is off.

2) Remove the end cover diagonally upward.

Remove the end covers from both ends of the robot unit. If difficult to remove the end cover, remove it while slightly twisting it right and left.



Remove end cover.

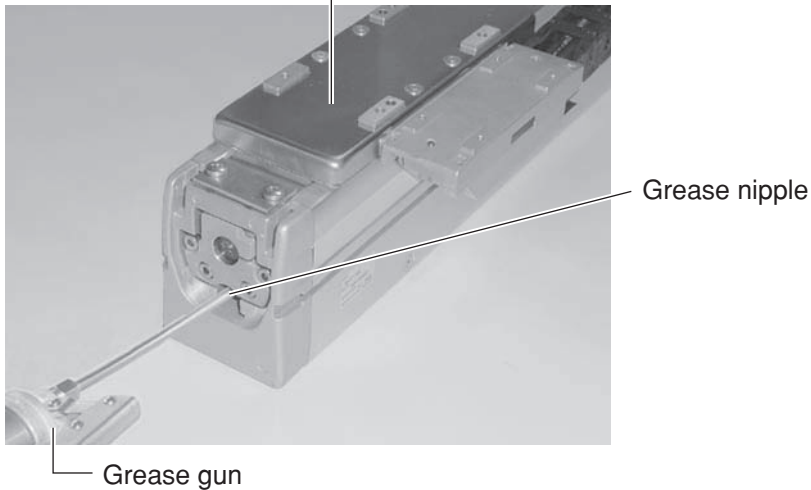
3) Move the slider all the way to either of the stroke ends.

The grease nipple is located in the lower part of the slider.

- 4) Insert the tip of the grease gun into the grease nipple inside the robot and fill with grease.

Grease quantity: 10cc

Slider should be positioned at stroke end.



- 5) Move the slider all the way to the opposite stroke end.
- 6) As in step 4), fill with grease through the grease nipple inside the robot.
- 7) Move the slider back and forth several times to help to spread the grease around.
- 8) Reattach the end covers.

## 5-3-2 MR16/MR16H

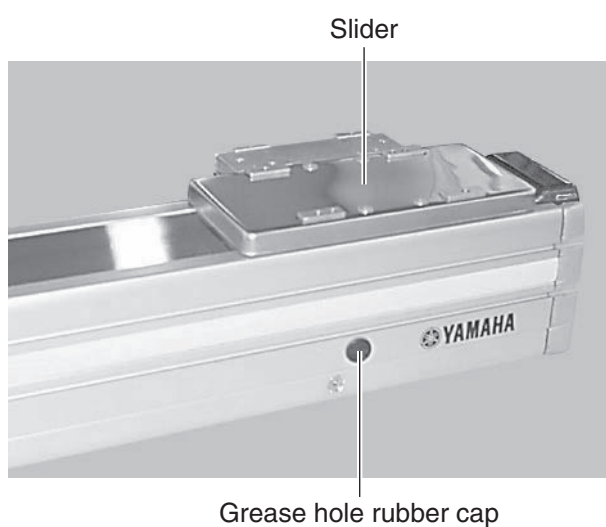
When applying grease to the MR16, use the grease hole (covered with rubber cap) on the side cover of the robot unit.

Before starting work, prepare the specified grease (See 5-2) and grease gun.

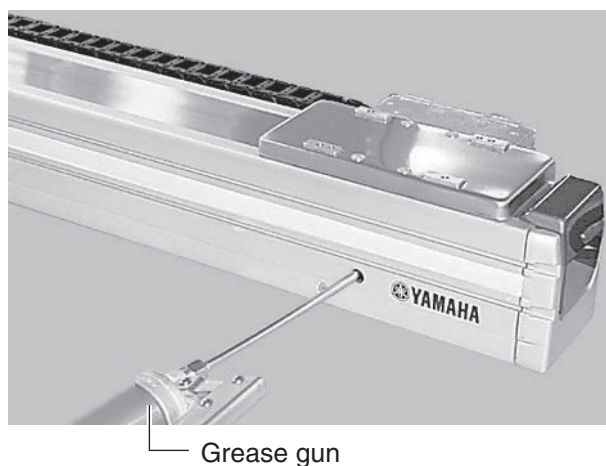
Recommended grease : Alvania No.2 (Shell), Daphne Eponex No.2 (Idemitsu)

Recommended grease gun : MG70 (THK) with N-type nozzle

- 1) Check that the controller power is off.
- 2) Move the slider all the way to the stroke end where the grease hole is located.



- 3) Remove the grease hole rubber cap on the side cover of the robot.
- 4) Insert the tip of the grease gun into the grease hole until it contacts the guide rail and fill with grease.  
Grease quantity: 10cc



**CAUTION**

Insert the tip of the grease gun into the grease hole until it contacts the guide rail and then fill with grease. If the gun is not inserted far enough inward, points other than the linear guide will be coated with grease.

- 5) Reattach the rubber cap to the grease hole.
- 6) Move the slider back and forth several times to help to spread the grease around.

### 5-3-3 MR20/MR25

When greasing the MR20/MR25, open the shutter and apply grease by hand to the guide rail. Before starting work, prepare the following grease and tools.

- Recommended grease: AFA (THK)
- Phillips screwdriver
- Precision slotted screwdriver

1) Check that the controller power is off.

2) Remove the side moldings.

Insert the precision screwdriver or a similar tool into the gap between the cover and the side molding, and separate the side molding from the cover.



3) Remove the end cover.

Loosen the screws (M4×2 pcs) holding each end cover and pull the end cover in the stroke direction (outward) to remove it.



#### CAUTION

**Only loosen the screws, and do not remove them.**

**If the screws are removed, the square nuts that hold the screws may drop and be lost.**



4) Remove the shutter clamp plate.

Loosen the screws (M4×2 pcs) holding the shutter clamp plate and remove the shutter clamp plate.

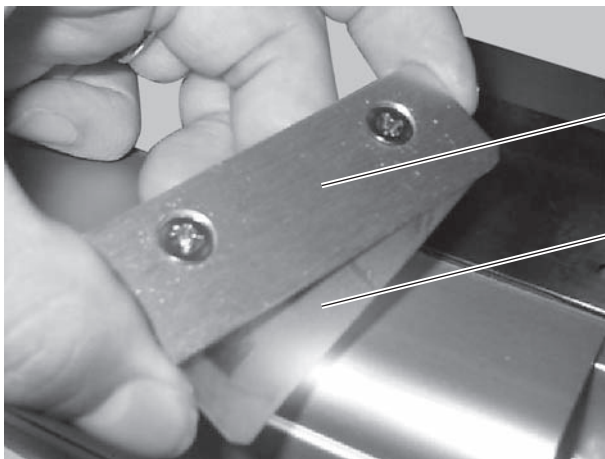


Shutter clamp plate



### CAUTION

The shutter clamp plate consists of an aluminum plate and a rubber busing.



Aluminum plate

Rubber busing

5) Peel back the shutter as shown and grease the guide rail by hand.

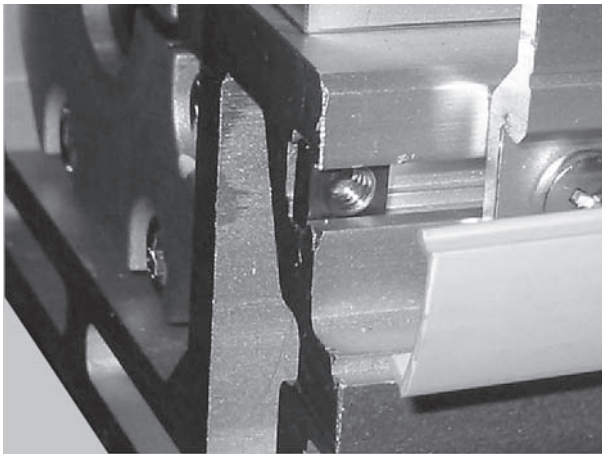


**CAUTION**

- Apply grease by hand. Using a metal tool such as a grease gun is dangerous because it will be attracted to the magnet.
- During work, the shutter must be kept open (pulled upward).  
Releasing the shutter or moving it right or left is very dangerous because it will be attracted to the magnet.  
If the shutter is attracted by the magnet, carefully pull it upward to separate from the magnet.

6) Carefully return the shutter to the original position and clamp it.

7) Insert the square nut for holding the end cover into the T-slot in the frame.



8) Reattach the end cover.

9) Reattach the side moldings.

## 5-4 Adjusting shutter slack

The shutter might sometimes elongate after long term use. If that happens adjust it as shown below.

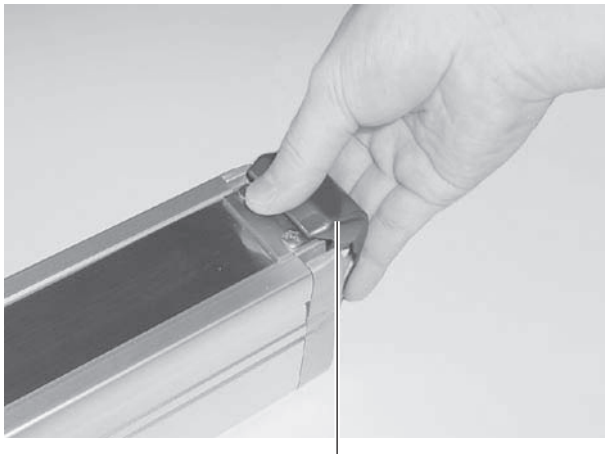
### 5-4-1 MR12

1) Check that the controller power is off.

2) Remove the end cover diagonally upwards.

Remove the end cover from either end of the robot unit. If difficult to remove the end cover, remove it while slightly twisting it right and left.

You will see two screws securing the shutter.



Remove end cover.

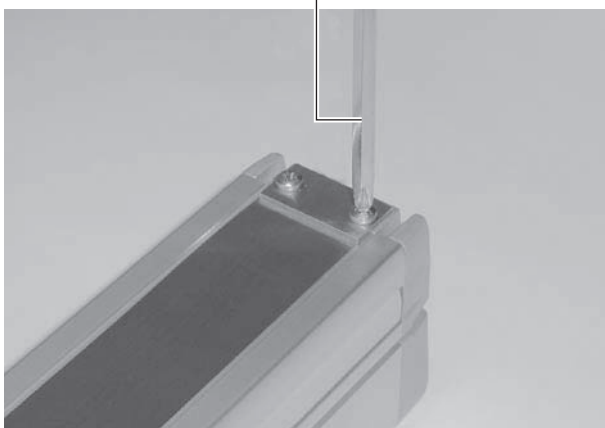
3) Loosen the two screws securing the shutter. (Do not remove.)



#### CAUTION

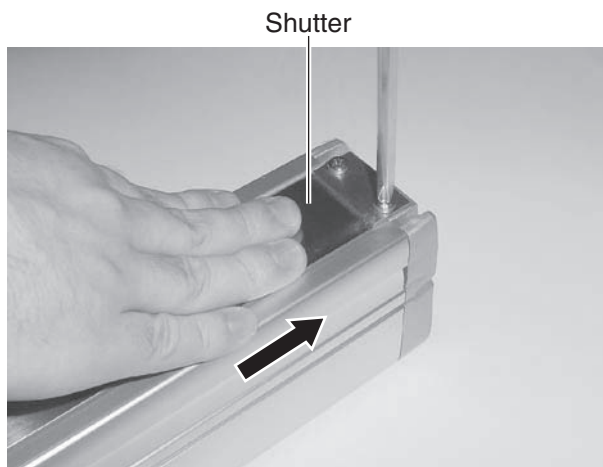
**Do not remove the screws securing the shutter. The shutter might stick itself to the magnet shaft or parts might drop inside the robot unit.**

Phillips screwdriver





- 4) While pushing the shutter towards the screw side with your fingers, tighten with the Phillips screwdriver and check it is not loose.

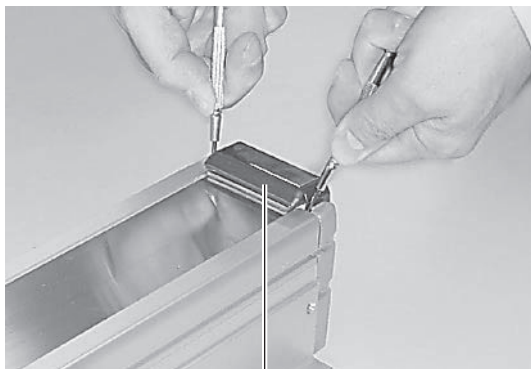
**CAUTION**

**Do not press down strongly on the shutter. Pressing strongly might warp the shutter.**

- 5) Move the slider back and forth several times and check for any slack or looseness in parts. Also check if any parts are binding during movement.
- 6) Fit the end cover back on from the lower side and install it back in its original position.

### 5-4-2 MR16/MR16H

- 1) Check that the controller power is off.
- 2) Insert precision screwdrivers or similar tools into the slots on both edges of the end cover as shown. While pressing inwards on the end cover from left and right, remove the end cover upwards. You will see two screws securing the shutter.



End cover

- 3) Loosen the two screws securing the shutter. (Do not remove.)



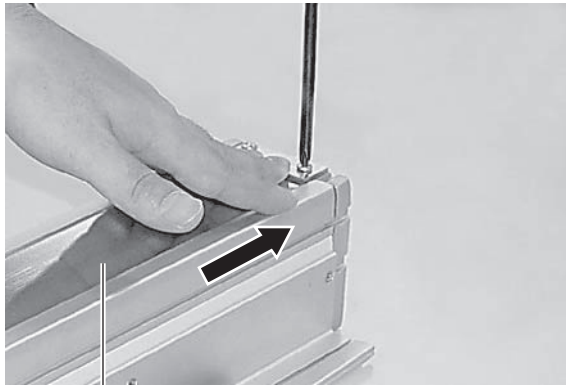
#### CAUTION

Do not remove the screws securing the shutter. The shutter might stick itself to the magnet shaft or parts might drop inside the robot unit.

Phillips screwdriver



- 4) While pushing the shutter towards the screw side with your fingers, tighten with the Phillips screwdriver and check it is not loose.



Shutter

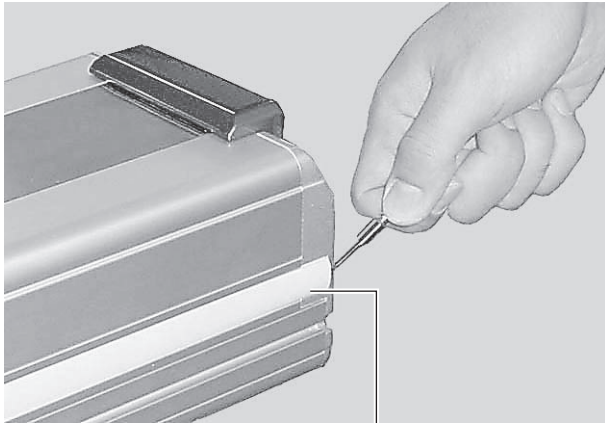
**CAUTION**

**Do not press down strongly on the shutter. Pressing strongly might warp the shutter.**

- 5) Move the slider back and forth several times and check for any slack or looseness in parts. Also check if any parts are binding during movement.
- 6) Fit the end cover back on from the lower side and install it back in its original position.

### 5-4-3 MR20/MR25

- 1) Check that the controller power is off.
- 2) Remove the side moldings as shown by using the tip of a precision screwdriver or similar tool. You can remove the side moldings from either end. You will see the screw securing the end cover to the robot body.

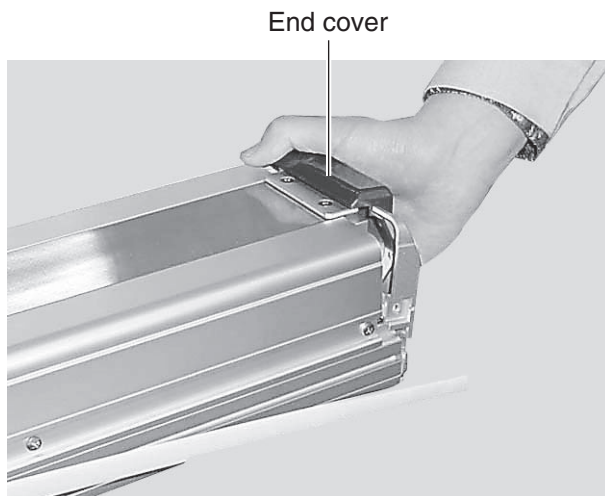


Side molding

- 3) Remove the screws securing the end cover. Two screws are aligned on one side of the robot body. Remove the screw on the outer side (nearer the end cover). Also remove the screw in the same position on the opposite side.



4) Remove the end cover. You will see two screws securing the shutter.



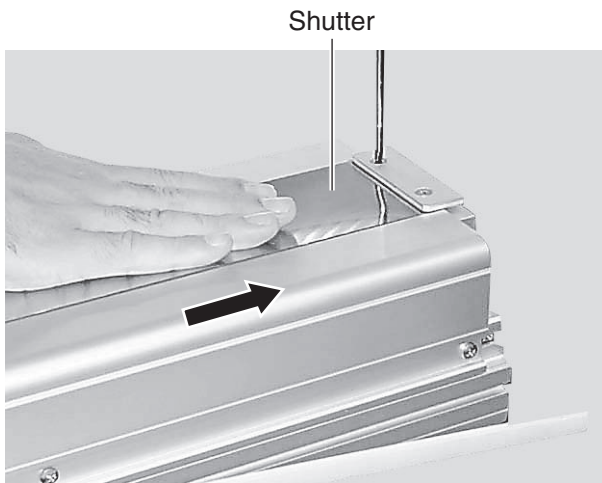
5) Loosen the two screws securing the shutter. (Do not remove.)

**CAUTION**

Do not remove the screws securing the shutter. The shutter might stick itself to the magnet shaft or parts might drop inside the robot unit.

## 5-4 Adjusting shutter slack

- 6) While pushing the shutter towards the screw side with your fingers, tighten with the Phillips screwdriver and check it is not loose.



### CAUTION

Do not press down strongly on the shutter. Pressing strongly might warp the shutter.

- 7) Move the slider back and forth several times and check for any slack or looseness in parts. Also check if any parts are binding during movement.
- 8) Attach the end cover and side moldings back in their original positions.

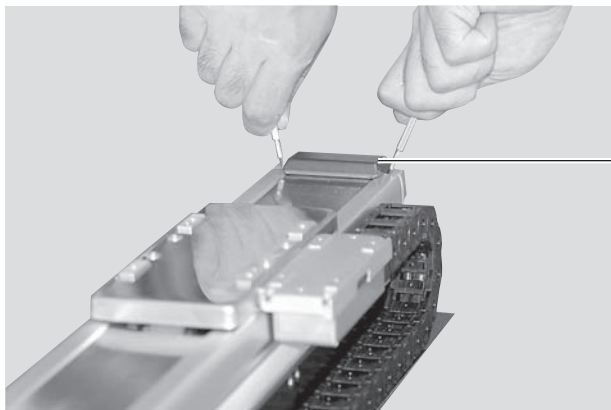
## 5-5 Replacing the shutter

### 5-5-1 MR12/MR16/MR16H

**WARNING**

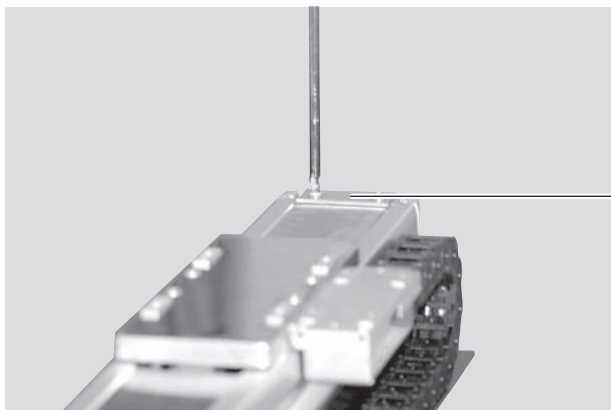
**BE CAREFUL NOT TO LET THE SHUTTER DROP INSIDE THE ROBOT BODY DURING SHUTTER REPLACEMENT. THIS COULD CAUSE BREAKDOWNS OR DAMAGE IN BOTH THE SHUTTER AND THE ROBOT.**

- 1) Make sure that the controller power is off.
- 2) Insert precision screwdrivers or similar tools into the slots on both edges of an end cover as shown. While pressing inwards on the end cover from left and right, remove the end cover upwards. Remove the two end covers since another end cover is located at the other end of the robot body.



End cover

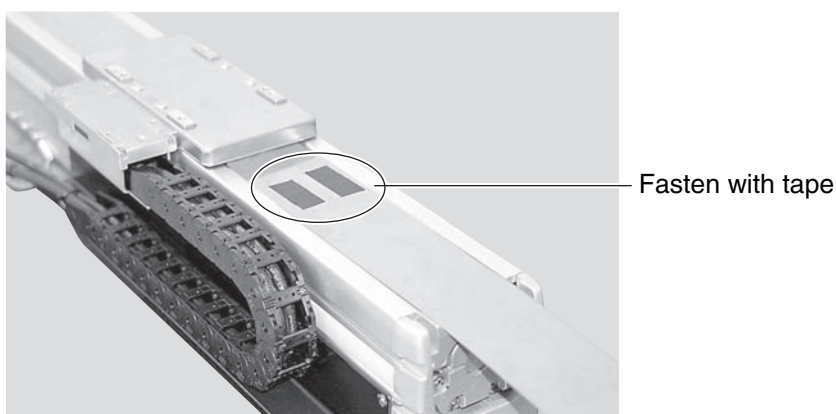
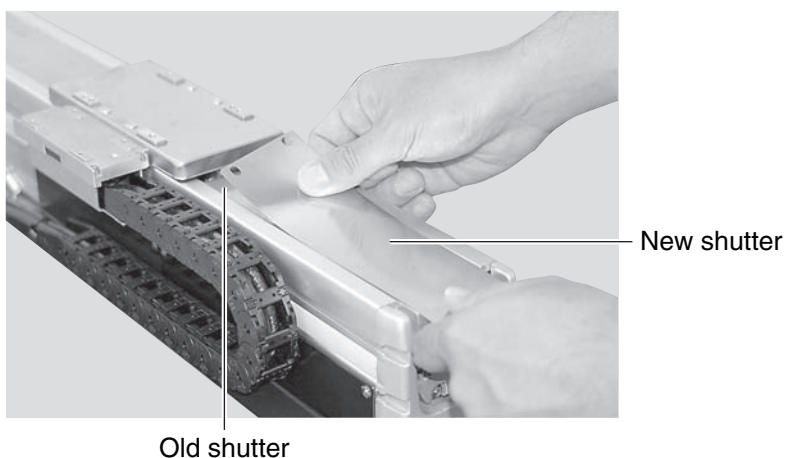
- 3) Remove both shutter clamp plates located at the ends of the robot body.



Shutter clamp plate

## 5-5 Replacing the shutter

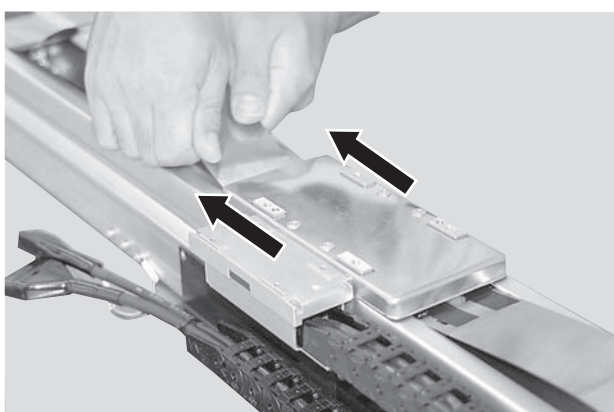
- 4) Fasten the new shutter onto the old shutter (for replacement) with tape as shown in the photo.



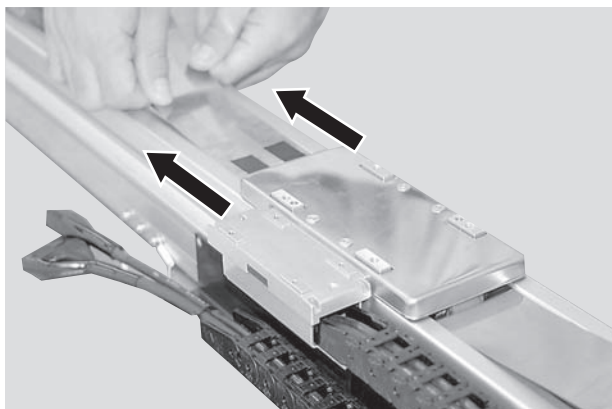
### CAUTION

Attach the tape strongly enough so it will not come loose during the pull-in task. If the tape is too thick the shutter will be impossible to pull in, so use tape with the right thickness such as insulating tape.

- 5) Pull gently on the old shutter as shown in the photo so that it will not come loose from the groove in the stroke cover, and draw in the new shutter. Be careful at this time not to let the new shutter twist, warp or hang up.







6) After finished installing the new shutter, adjust its position. Make sure that there is no looseness or slack in the shutter and then reinstall the shutter clamp plate. When adjusting the shutter slack, refer to "5-4 Adjusting shutter slack".

7) Reattach the end covers.

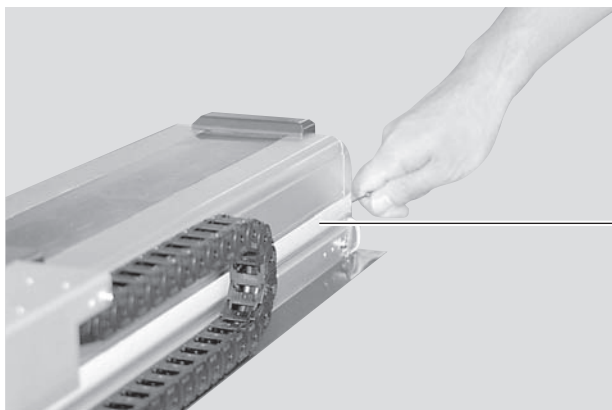
### 5-5-2 MR20/MR25



#### WARNING

**BE CAREFUL NOT TO LET THE SHUTTER DROP INSIDE THE ROBOT BODY DURING SHUTTER REPLACEMENT. THIS COULD CAUSE BREAKDOWNS OR DAMAGE IN BOTH THE SHUTTER AND THE ROBOT.**

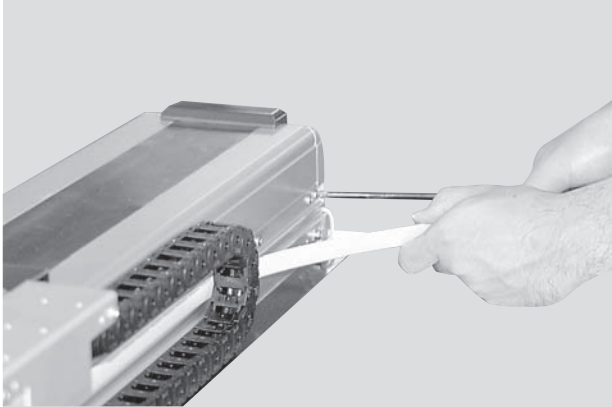
- 1) Make sure that the controller power is off.
- 2) Remove the side moldings as shown by using the tip of a precision screwdriver or similar tool. You can remove the side moldings from either end.



Side molding

## 5-5 Replacing the shutter

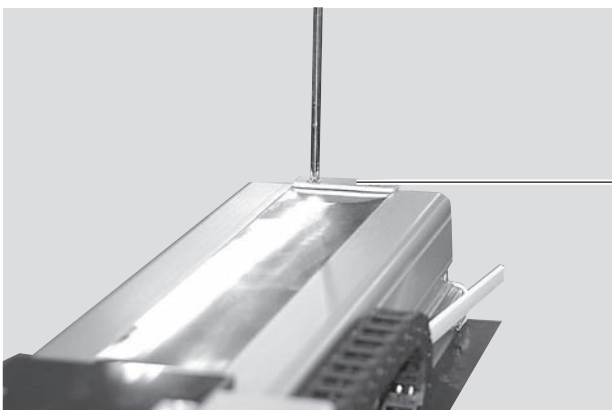
- 3) Remove the screws securing the end covers at both ends of the robot body.



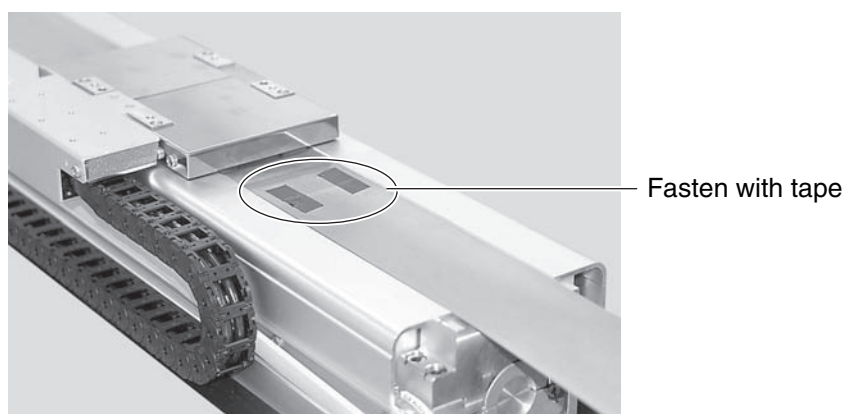
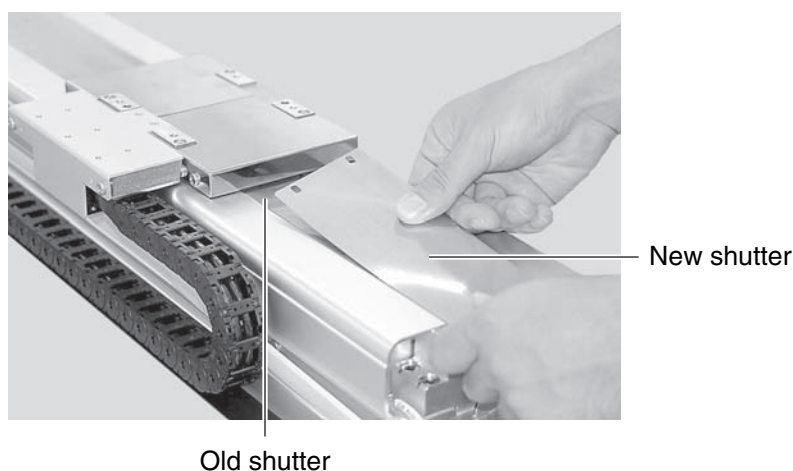
- 4) Remove the end covers from both ends of the robot body.



- 5) Remove both shutter clamp plates located at the ends of the robot body.

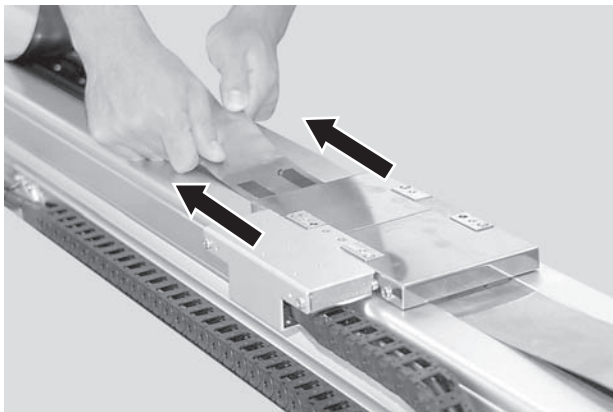
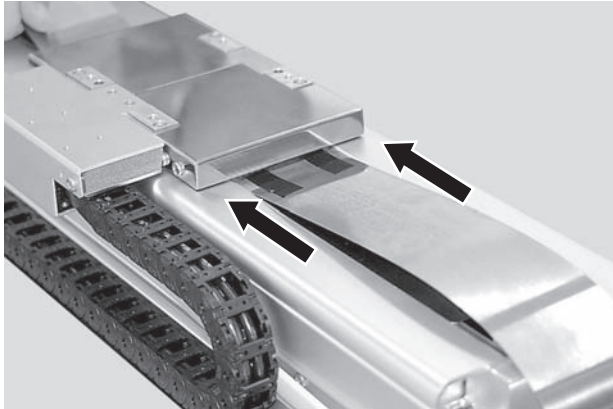


- 6) Fasten the new shutter onto the old shutter (for replacement) with tape as shown in the photo.

**CAUTION**

Attach the tape strongly enough so it will not come loose during the pull-in task. If the tape is too thick the shutter will be impossible to pull in, so use tape with the right thickness such as insulating tape.

- 7) Pull gently on the old shutter as shown in the photo so that it will not come loose from the groove in the stroke cover, and draw in the new shutter. Be careful at this time not to let the new shutter twist, warp or hang up.



- 8) After finished installing the new shutter, adjust its position. Make sure that there is no looseness or slack in the shutter and then reinstall the shutter clamp plate. When adjusting the shutter slack, refer to "5-4 Adjusting shutter slack".
- 9) Reattach the end covers and side moldings.

### Contents

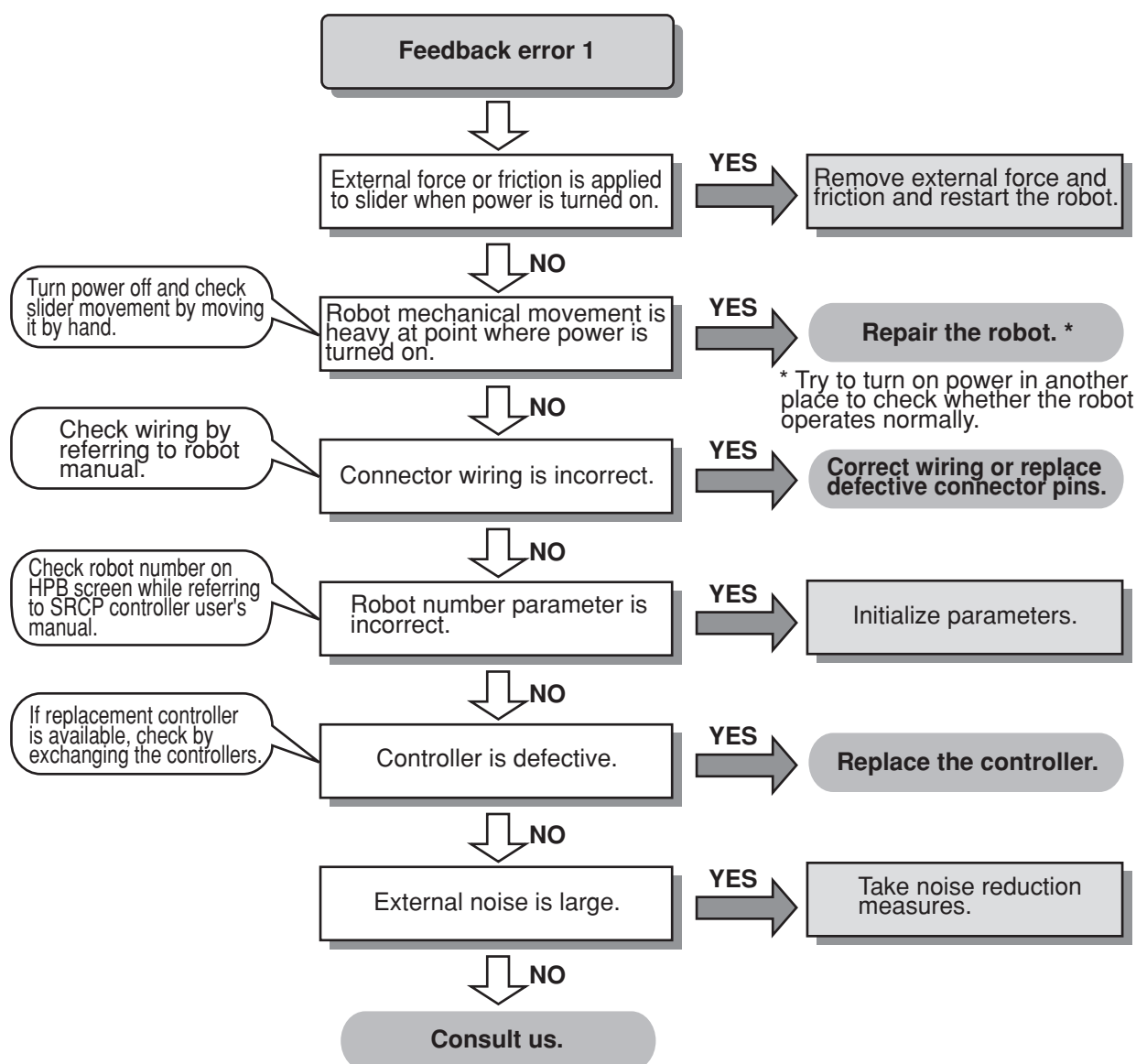
6-1	If you suspect trouble	6-1
6-2	Feedback error	6-1
6-3	Magnetic pole detection error	6-3
6-4	Overload	6-4



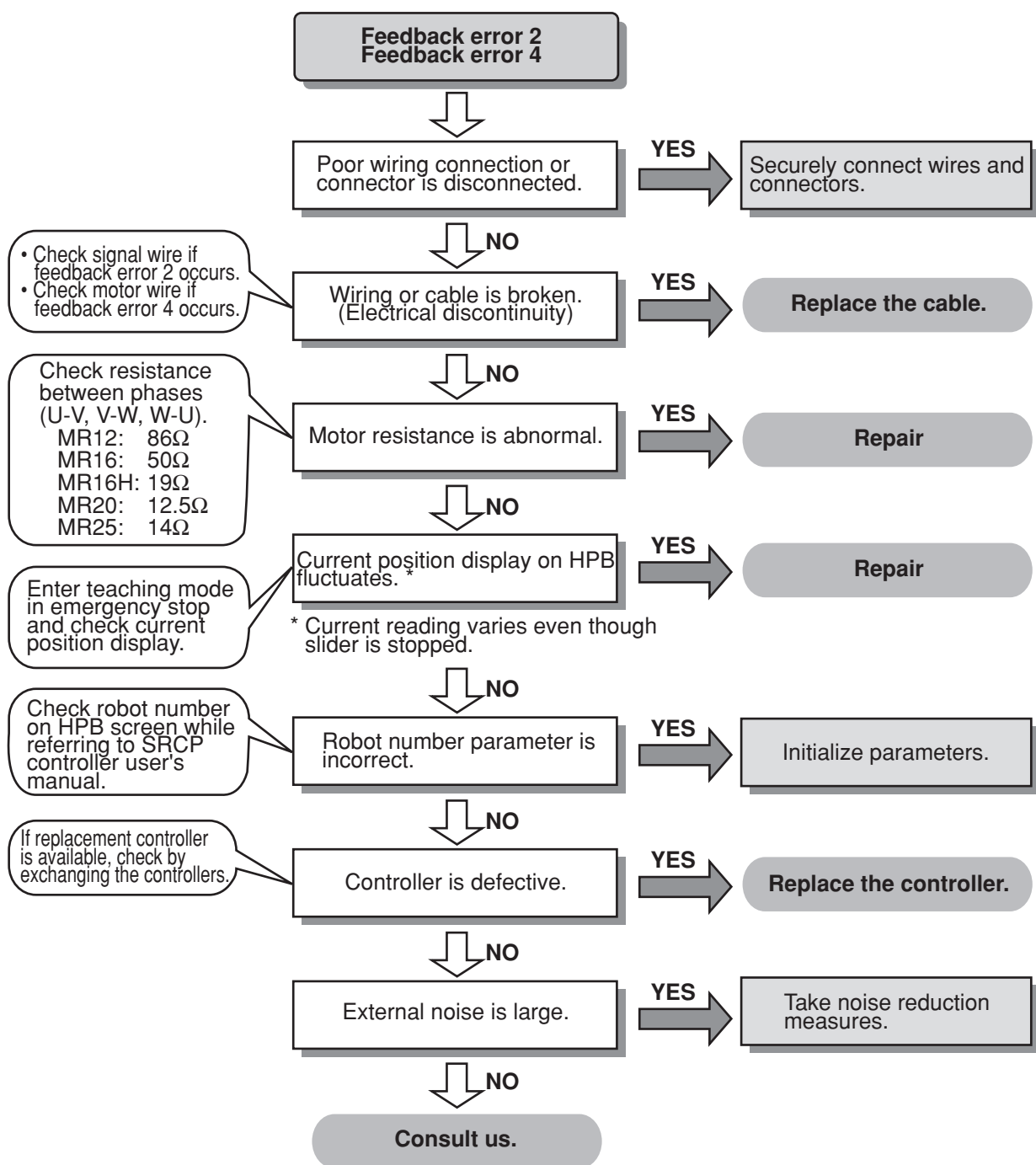
## 6-1 If you suspect trouble

If an error such as a feedback error and overload occurs, check the following points to find the solution before you determine the robot or controller has malfunctioned. If the trouble still exists even after checking these points, please contact us with a detailed description of the trouble.

## 6-2 Feedback error



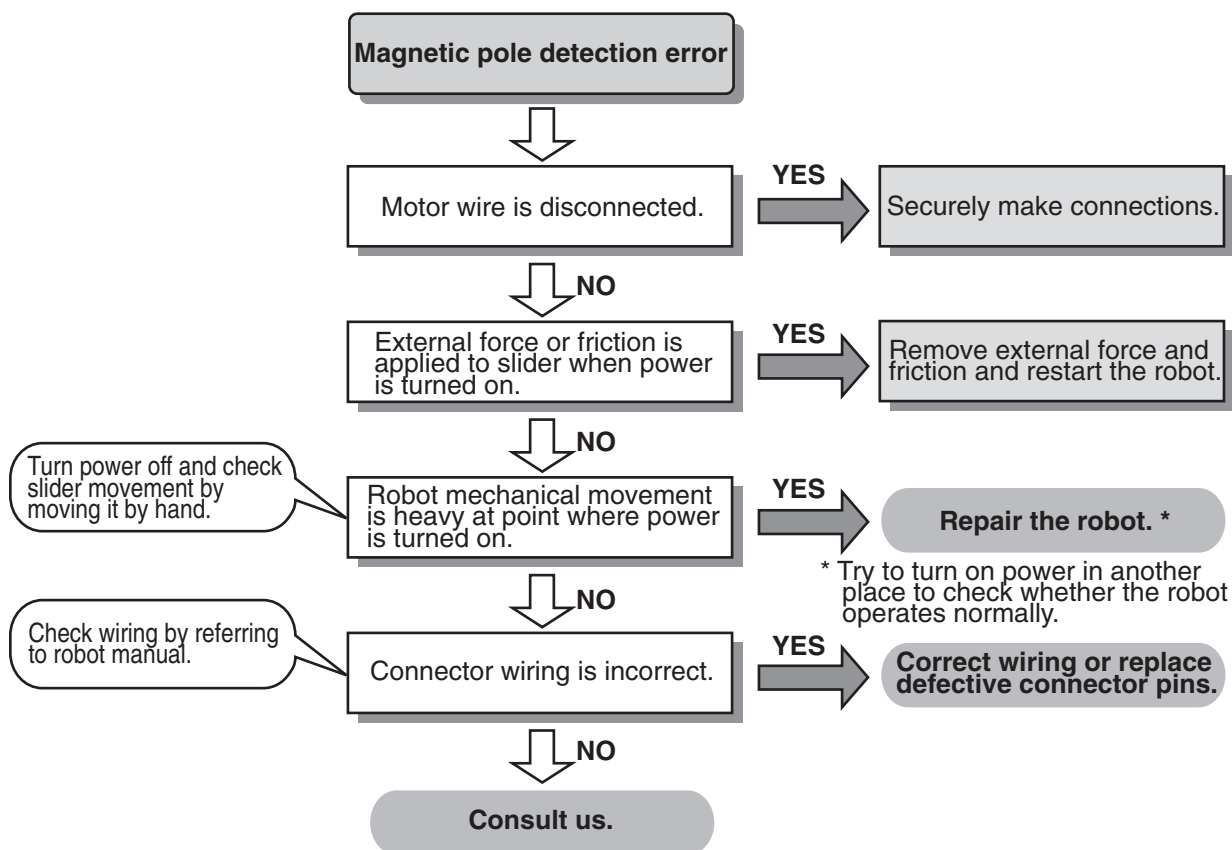
Requires repair or parts replacement.  
Contact us.




Requires repair or parts replacement.  
Contact us.

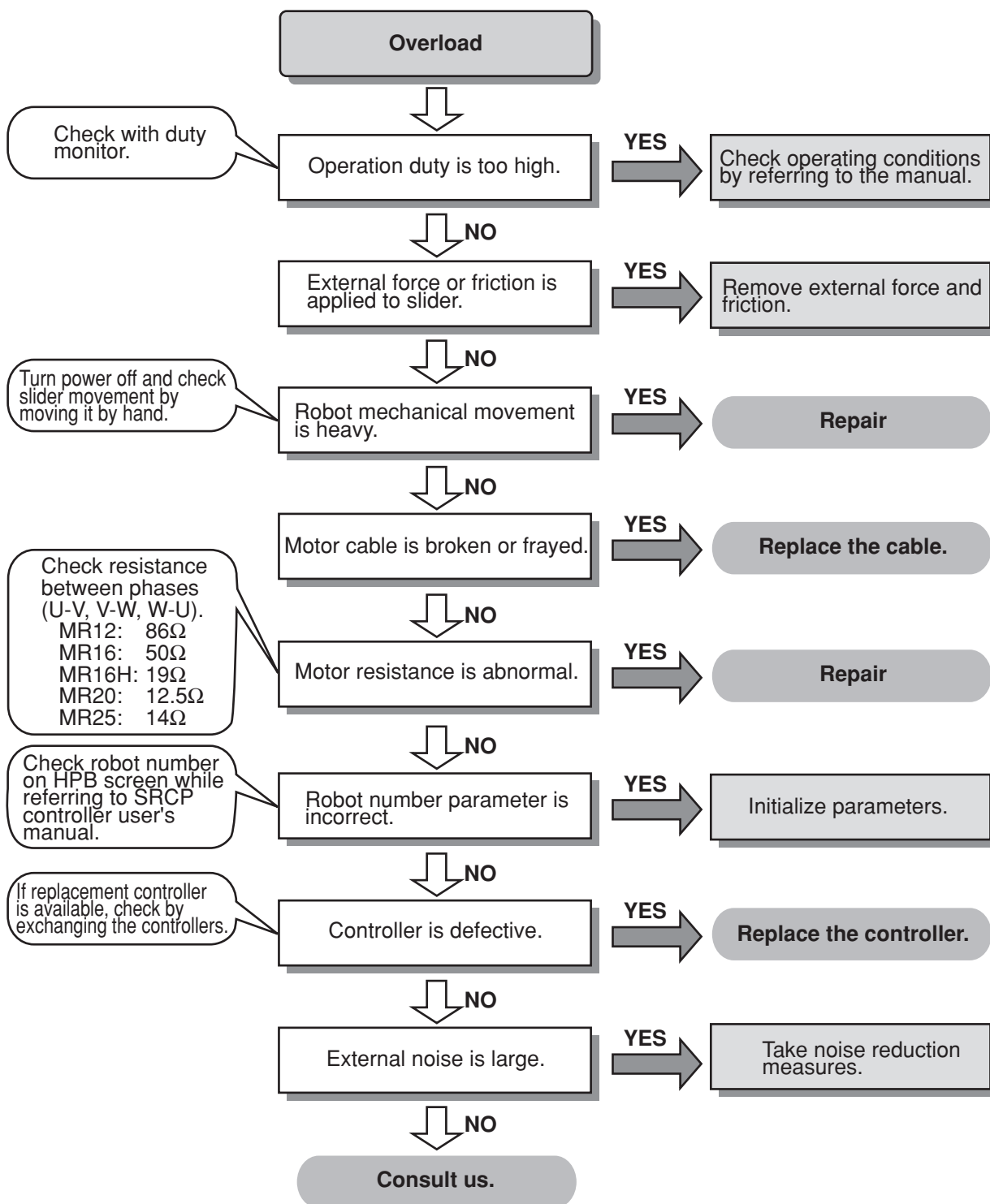


## 6-3 Magnetic pole detection error



 Requires repair or parts replacement. Contact us.

## 6-4 Overload



Requires repair or parts replacement.  
Contact us.

## Contents

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## 7-1 Main unit

### 7-1-1 MR12/MR12D

#### ● Basic specifications

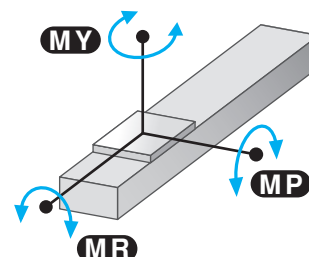
Robot model	MR12	MR12D
Repeatability (positioning accuracy)	Within $\pm 5\mu\text{m}$	
Maximum cross-section outside dimensions	W60×H90mm (excluding cable carrier)	
Total length	Stroke length +288mm	Stroke length +488mm
Bearing method	Single guide rail with 2 bearing blocks (with built-in retainer)	
Drive system / shaft diameter	Shaft motor / 12mm diameter	
Scale	Magnetic method: resolution $1\mu\text{m}$	
Rated thrust	18N	
Maximum payload	5kg	
Maximum speed	2500mm/sec <sup>*1</sup>	
Maximum stroke	1050mm	
Controller	SRCP, SR1-P, RCX221, RDP	

<sup>\*1</sup>: Maximum speed may not be obtained depending on operating conditions.

#### ● Static loading moment

(Unit: N·m)

MY	MP	MR
107	107	89



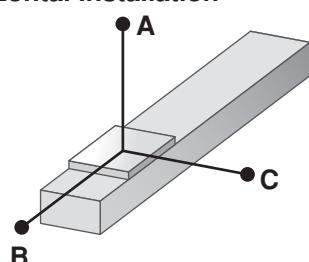
#### ● Tolerable overhang amount <sup>\*2</sup>

(Unit: mm)

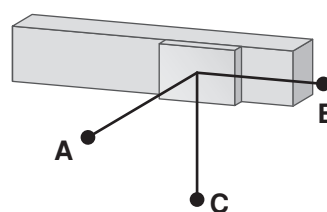
	Horizontal installation			Wall installation		
	A	B	C	A	B	C
1kg	600	600	600	600	600	600
2kg	1200	1200	598	529	1200	1200
3kg	1800	1800	406	323	1450	1800
5kg	3000	1561	241	162	589	3000

<sup>\*2</sup>: Distance from center of slider top to center of gravity of object being carried.

Horizontal installation



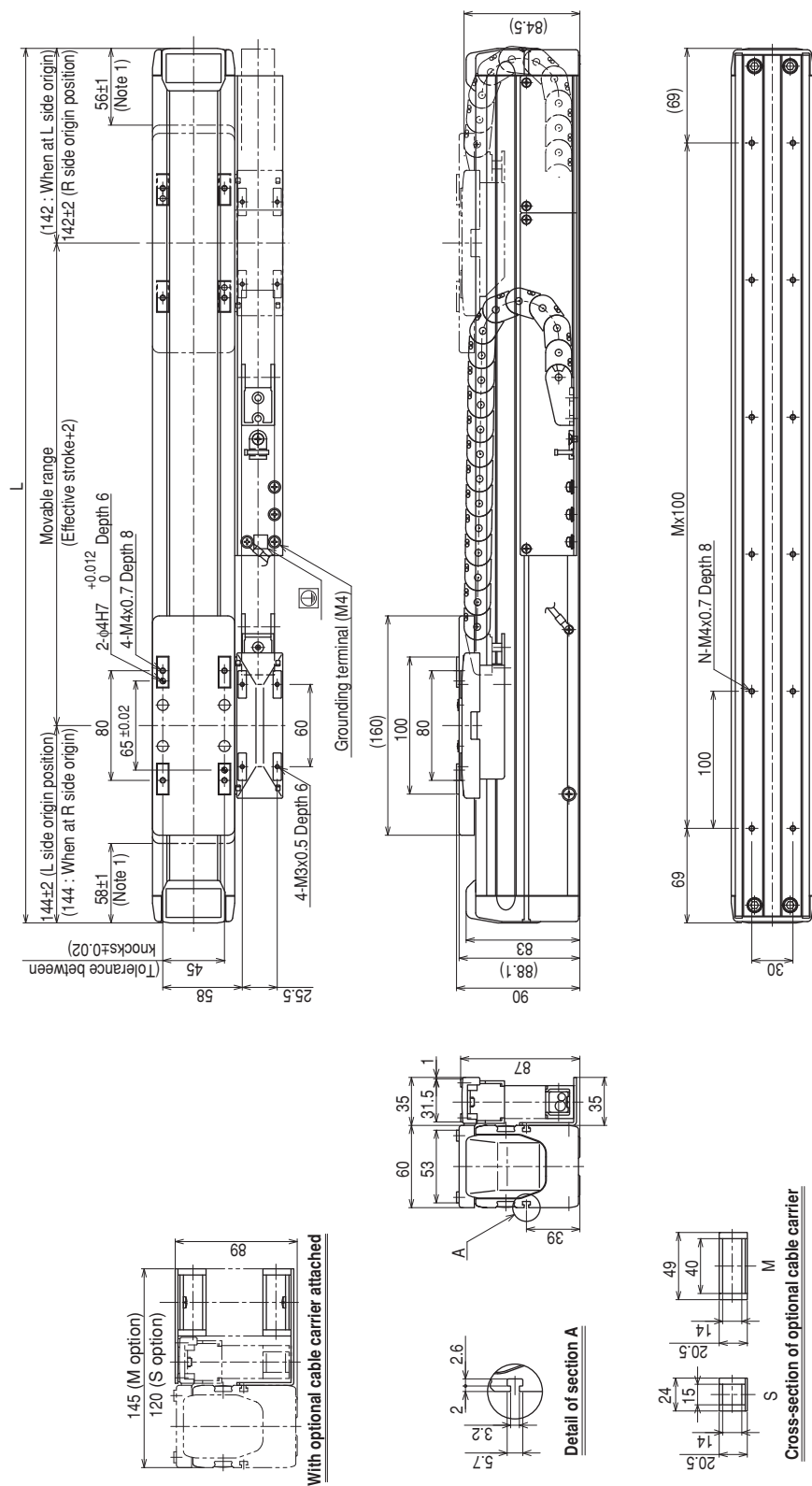
Wall installation



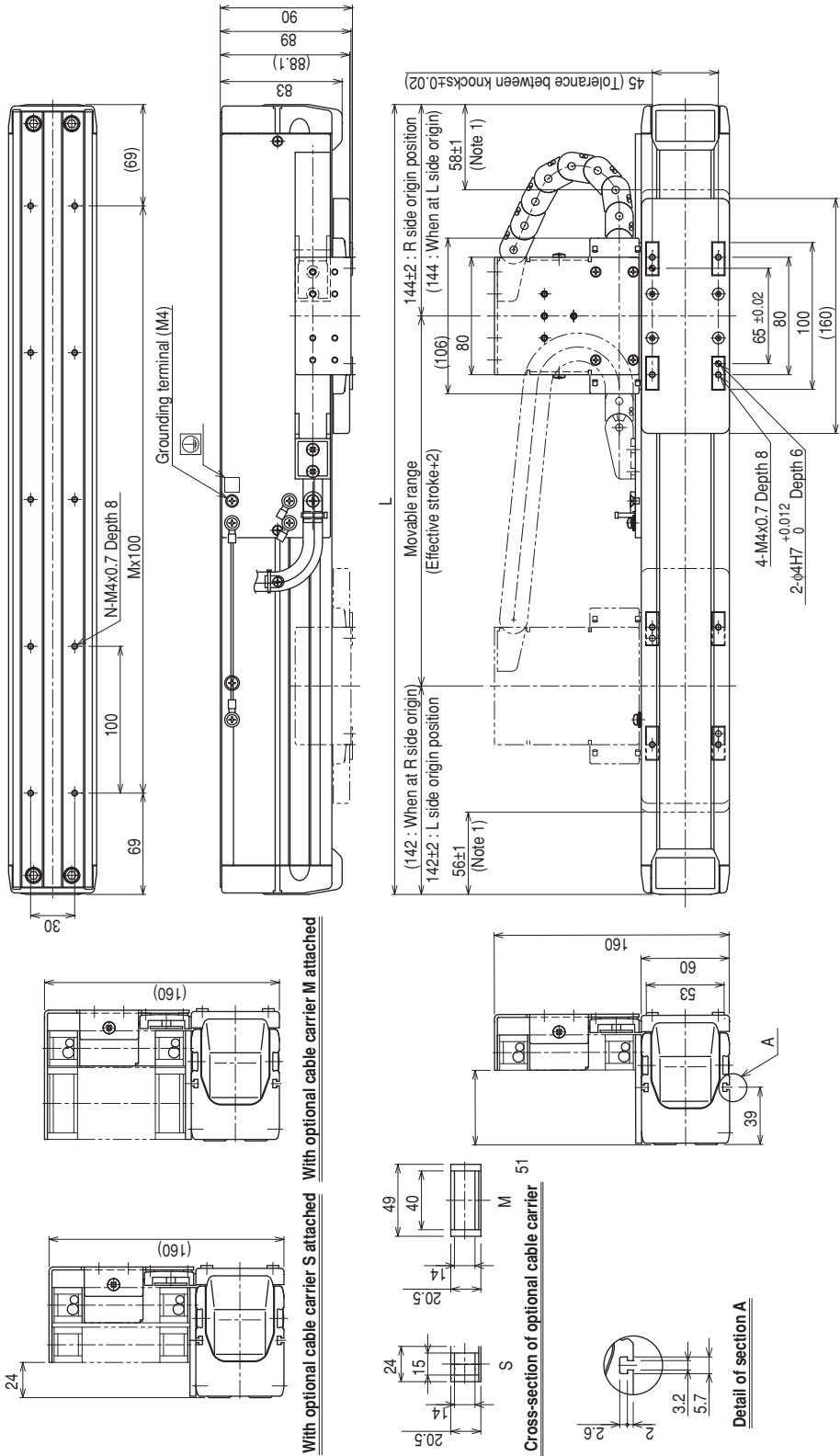
## MR12 single-carriage horizontal mount model

Effective stroke	50	150	250	350	450	550	650	750	850	950	1050
L	338	438	538	638	738	838	938	1038	1138	1238	1338
M	2	3	4	5	6	7	8	9	10	11	12
N	6	8	10	12	14	16	18	20	22	24	26
Weight (kg)	3.9	4.4	5.0	5.6	6.1	6.7	7.3	7.9	8.4	9.0	9.5

Note 1. Distance from both ends to the mechanical stopper.  
 \* The origin is set on the L side at the time of shipment. It can be changed to the R side by parameter setting.



MR12 single-carriage wall mount model



Note 1. Distance from both ends to the mechanical stopper.  
\* The origin is set on the R side at the time of shipment. It can be changed to the L side by parameter setting.

Effective stroke	50	150	250	350	450	550	650	750	850	950	1050
L	338	438	538	638	738	838	938	1038	1138	1238	1338
M	2	3	4	5	6	7	8	9	10	11	12
N	6	8	10	12	14	16	18	20	22	24	26
Weight (kg)	3.9	4.4	5.0	5.6	6.1	6.7	7.3	7.9	8.4	9.0	9.5

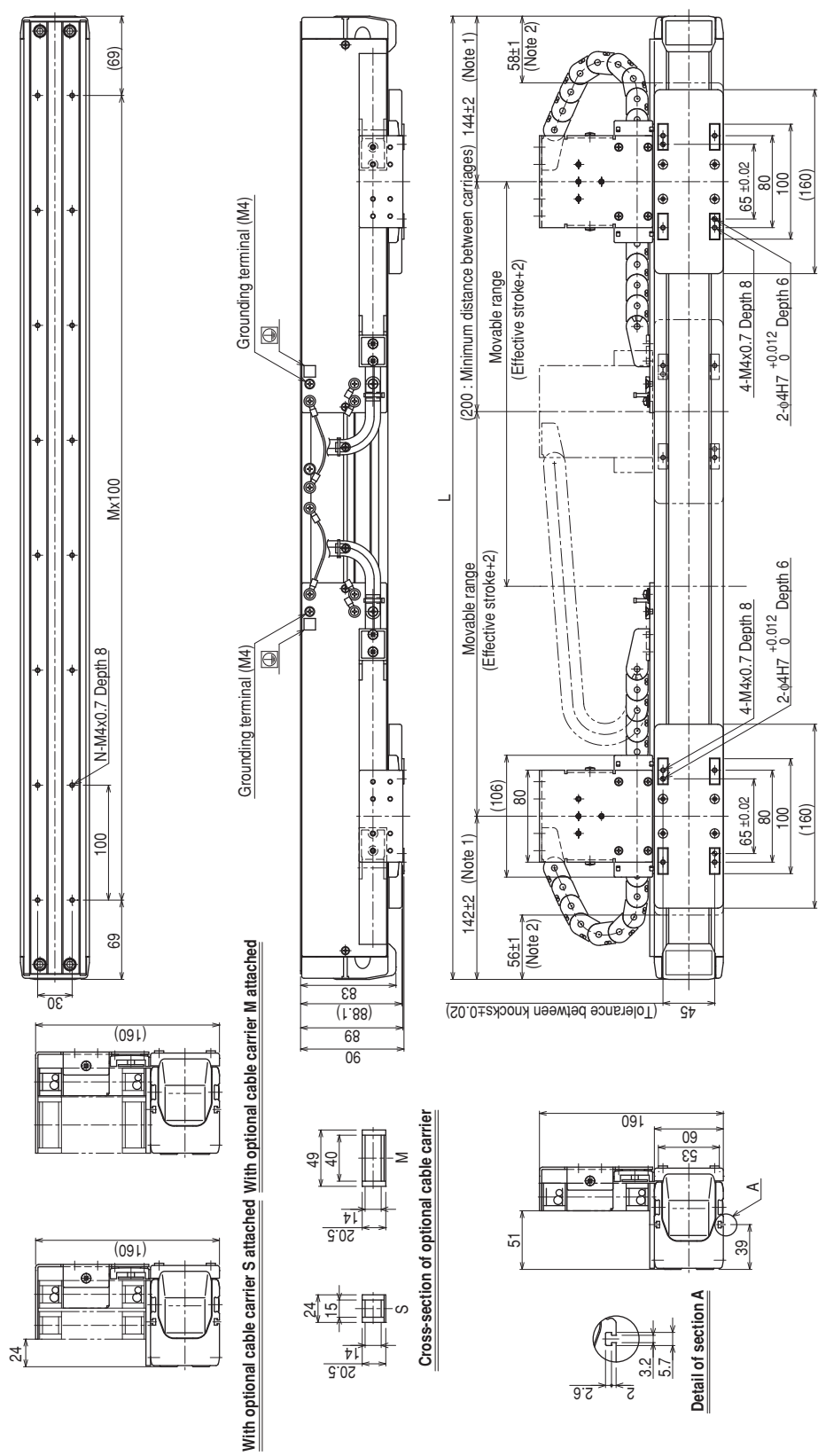
**7-4**



Effective stroke	50	150	250	350	450	550	650	750	850	950	1050
L	538	638	738	838	938	1038	1138	1238	1338	1438	1538
M	4	5	6	7	8	9	10	11	12	13	14
N	10	12	14	16	18	20	22	24	26	28	30
Weight (kg)	5.7	6.3	6.8	7.3	8.0	8.6	9.1	9.7	10.2	10.8	11.3



MR12D double-carriage wall mount model



Note 1. Position of the table slider when returned to the origin.  
Note 2. Distance from both ends to the mechanical stopper.

Effective stroke	50	150	250	350	450	550	650	750	850	950	1050
L	538	638	738	838	938	1038	1138	1238	1338	1438	1538
M	4	5	6	7	8	9	10	11	12	13	14
N	10	12	14	16	18	20	22	24	26	28	30
Weight (kg)	5.7	6.3	6.8	7.3	8.0	8.6	9.1	9.7	10.2	10.8	11.3

## 7-1-2 MR16/MR16D

## ● Basic specifications

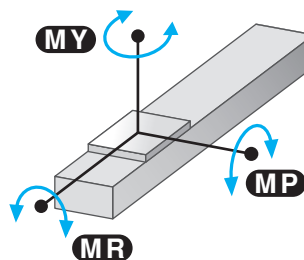
Robot model	MR16	MR16D
Repeatability (positioning accuracy)	Within $\pm 5\mu\text{m}$	
Maximum cross-section outside dimensions	W80×H100mm (excluding cable carrier)	
Total length	Stroke length +288mm	Stroke length +488mm
Bearing method	Thin, wide linear guide (with lubricant seals)	
Drive system / shaft diameter	Shaft motor / 16mm diameter	
Scale	Magnetic method: resolution 1 $\mu\text{m}$	
Rated thrust	27N	
Maximum payload	7kg	
Maximum speed	2500mm/sec <sup>*1</sup>	
Maximum stroke	1550mm	1450mm
Controller	SRCP, SR1-P, RCX221, RDP	

<sup>\*1</sup>: Maximum speed may not be obtained depending on operating conditions.

## ● Static loading moment

(Unit: N·m)

MY	MP	MR
148	148	113

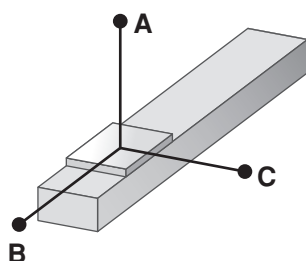
● Tolerable overhang amount <sup>\*2</sup>

(Unit: mm)

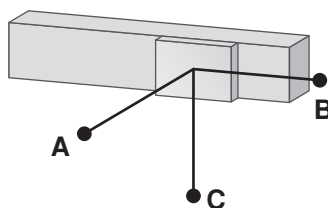
	Horizontal installation			Wall installation		
	A	B	C	A	B	C
1kg	600	600	600	600	600	600
3kg	1800	1800	274	208	1800	1800
5kg	3000	1601	163	94	779	2570
7kg	3411	1156	115	45	0	1525

<sup>\*2</sup>: Distance from center of slider top to center of gravity of object being carried.

Horizontal installation

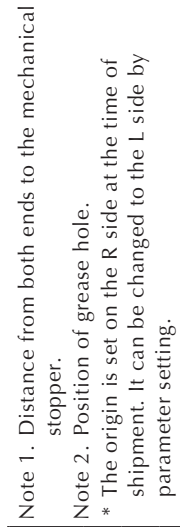


Wall installation





**7-8**



Effective stroke	50	150	250	350	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550
L	338	438	538	638	738	838	938	1038	1138	1238	1338	1438	1538	1638	1738	1838
M	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
N	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
Weight (kg)	5.8	6.7	7.6	8.6	9.5	10.4	11.4	12.3	13.2	14.2	15.1	16.0	16.9	17.9	18.8	19.8

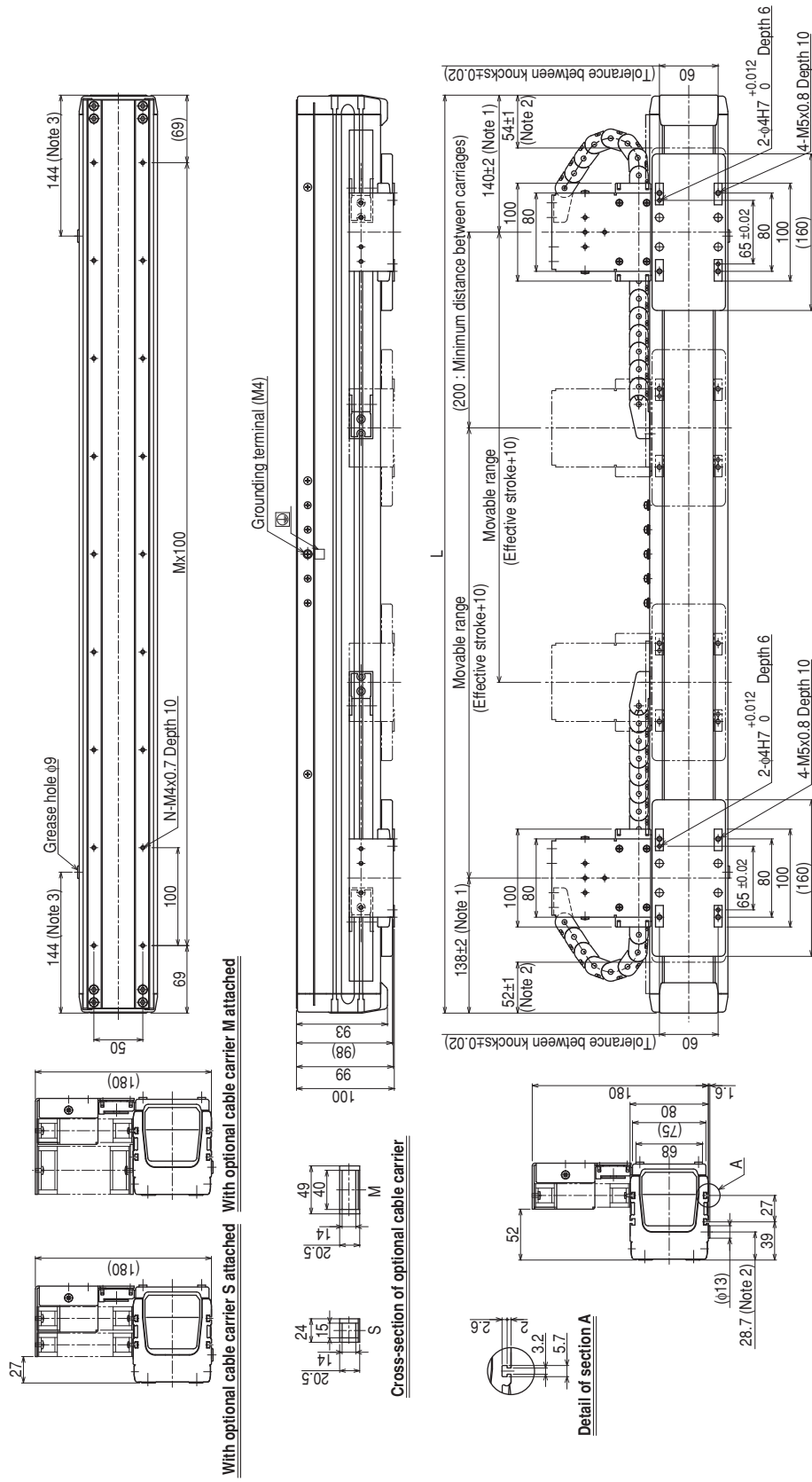
Note 1. Position of the table slider when returned to the origin.

Note 2. Distance from both ends to the mechanical stopper.

Note 3. Position of grease hole.

**7-9**

## MR16D double-carriage wall mount model



Note 1. Position of the table slider when returned to the origin.

Note 2. Distance from both ends to the mechanical stopper.

Note 3. Position of grease hole.

Effective stroke	50	150	250	350	450	550	650	750	850	950	1050	1150	1250	1350	1450
L	538	638	738	838	938	1038	1138	1238	1338	1438	1538	1638	1738	1838	1938
M	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
N	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
Weight (kg)	8.7	9.7	10.6	11.5	12.5	13.4	14.3	15.3	16.2	17.1	18.0	19.0	19.9	20.9	21.8

## 7-1-3 MR16H/MR16HD

### ● Basic specifications

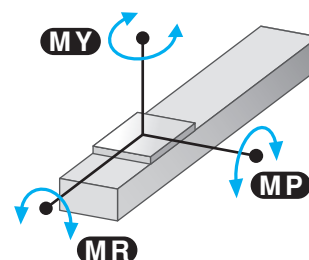
Robot model	MR16H	MR16HD
Repeatability (positioning accuracy)	Within $\pm 5\mu\text{m}$	
Maximum cross-section outside dimensions	W80×H100mm (excluding cable carrier)	
Total length	Stroke length +338mm	Stroke length +588mm
Bearing method	Thin, wide linear guide (with lubricant seals)	
Drive system / shaft diameter	Shaft motor / 16mm diameter	
Scale	Magnetic method: resolution $1\mu\text{m}$	
Rated thrust	37N	
Maximum payload	9kg	
Maximum speed	2500mm/sec <sup>*1</sup>	
Maximum stroke	1500mm	1300mm
Controller	SRCP, SR1-P, RCX221, RDP	

<sup>\*1</sup>: Maximum speed may not be obtained depending on operating conditions.

### ● Static loading moment

(Unit: N·m)

MY	MP	MR
189	190	113



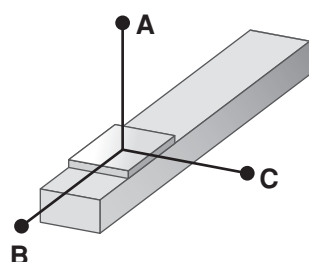
### ● Tolerable overhang amount <sup>\*2</sup>

(Unit: mm)

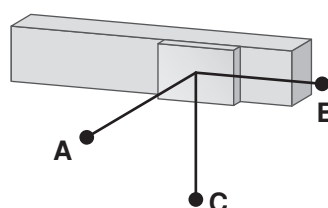
	Horizontal installation			Wall installation		
	A	B	C	A	B	C
3kg	1800	1800	272	208	1800	1800
5kg	2901	2391	162	94	1171	1745
7kg	2541	1726	114	45	0	1130
9kg	2846	1366	88	18	0	840

<sup>\*2</sup>: Distance from center of slider top to center of gravity of object being carried.

Horizontal installation



Wall installation



**7-12**



\* The origin is set on the L side at the time of shipment. It can be changed to the R side by parameter setting.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
L	438	538	638	738	838	938	1038	1138	1238	1338	1438	1538	1638	1738	1838
M	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
N	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
Weight (kg)	7.1	8.0	9.0	9.9	10.8	11.8	12.7	13.6	14.6	15.5	16.4	17.3	18.3	19.2	20.2





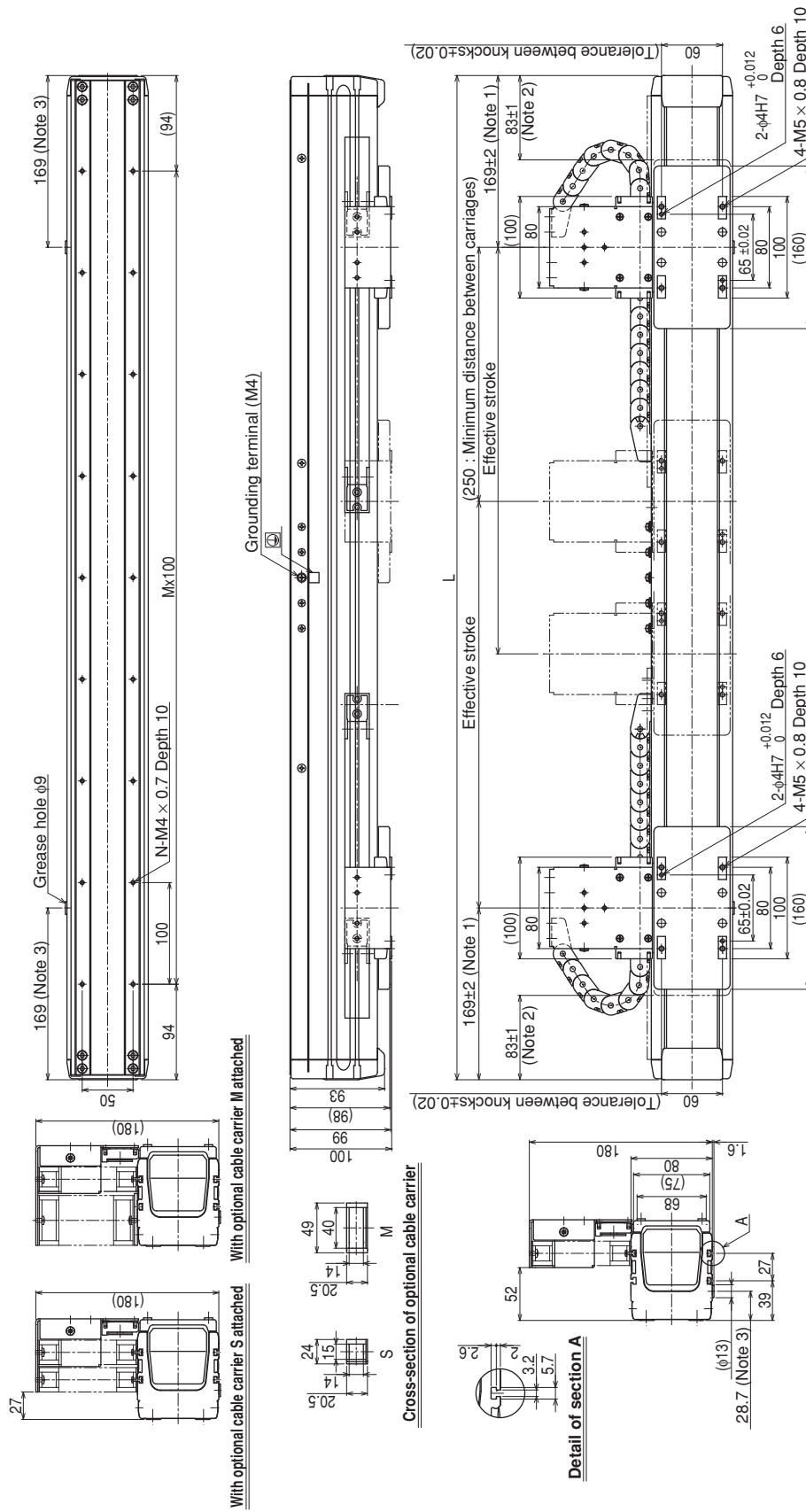
**7-14**



Note 3. Position of grease hole.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300
L	688	788	888	988	1088	1188	1288	1388	1488	1588	1688	1788	1888
M	5	6	7	8	9	10	11	12	13	14	15	16	17
N	12	14	16	18	20	22	24	26	28	30	32	34	36
Weight (kg)	10.9	11.8	12.7	13.7	14.6	15.3	16.3	17.4	18.3	19.2	20.2	21.1	22.1

## MR16HD double-carriage wall mount model



Note 1. Position of the table slider when returned to the origin.

Note 2. Distance from both ends to the mechanical stopper.

Note 3. Position of grease hole.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300
L	688	788	888	988	1088	1188	1288	1388	1488	1588	1688	1788	1888
M	5	6	7	8	9	10	11	12	13	14	15	16	17
N	12	14	16	18	20	22	24	26	28	30	32	34	36
Weight (kg)	10.9	11.8	12.7	13.7	14.6	15.3	16.3	17.4	18.3	19.2	20.2	21.1	22.1

## 7-1-4 MR20/MR20D

## ● Basic specifications

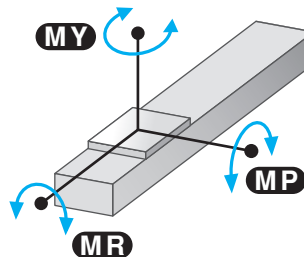
Robot model	MR20	MR20D
Repeatability (positioning accuracy)	Within $\pm 5\mu\text{m}$	
Maximum cross-section outside dimensions	W145×H120mm (excluding cable carrier)	
Total length	Stroke length +350mm	Stroke length +650mm
Bearing method	2 guide rails and 4 bearing blocks (with retainers)	
Drive system / shaft diameter	Shaft motor / 20mm diameter	
Scale	Magnetic method: resolution 1 $\mu\text{m}$	
Rated thrust	70N	
Maximum payload	17kg	
Maximum speed	2500mm/sec <sup>*1</sup>	
Maximum stroke	2000mm	1700mm
Controller	SRCP, SR1-P, RCX221, RDP	

<sup>\*1</sup>: Maximum speed may not be obtained depending on operating conditions.

## ● Static loading moment

(Unit: N·m)

MY	MP	MR
306	306	269

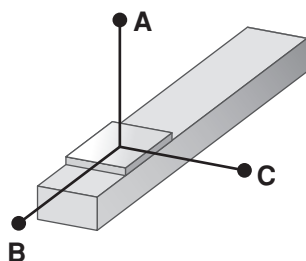
● Tolerable overhang amount <sup>\*2</sup>

(Unit: mm)

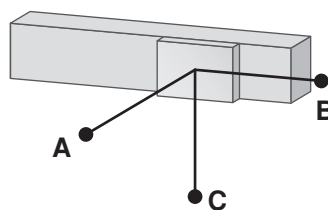
	Horizontal installation			Wall installation		
	A	B	C	A	B	C
5kg	3000	3000	1326	1328	2650	2736
10kg	2458	1744	748	702	1202	1876
17kg	1979	1055	463	389	605	1355

<sup>\*2</sup>: Distance from center of slider top to center of gravity of object being carried.

Horizontal installation

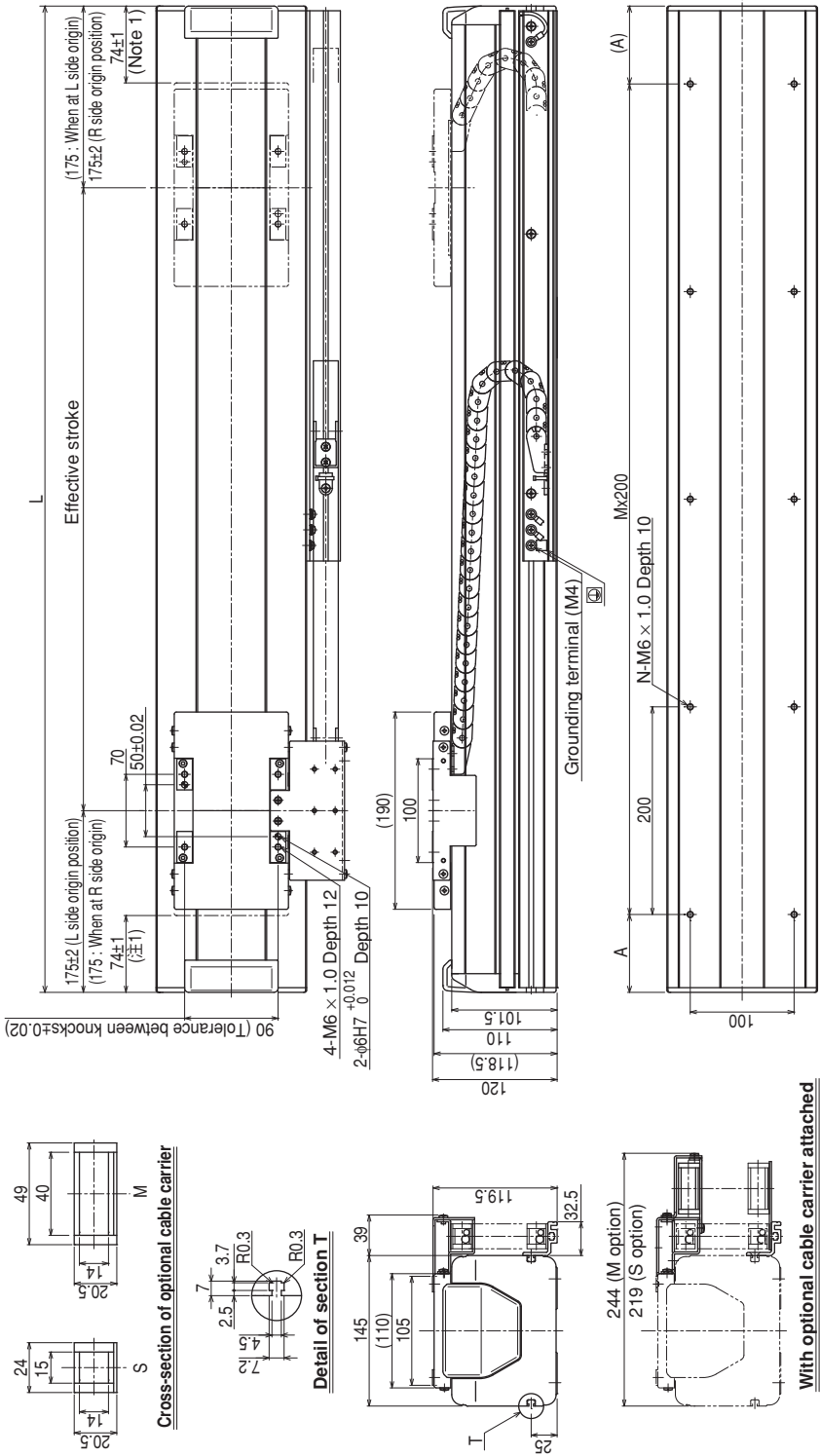


Wall installation



● Dimensions

MR20 single-carriage horizontal mount model

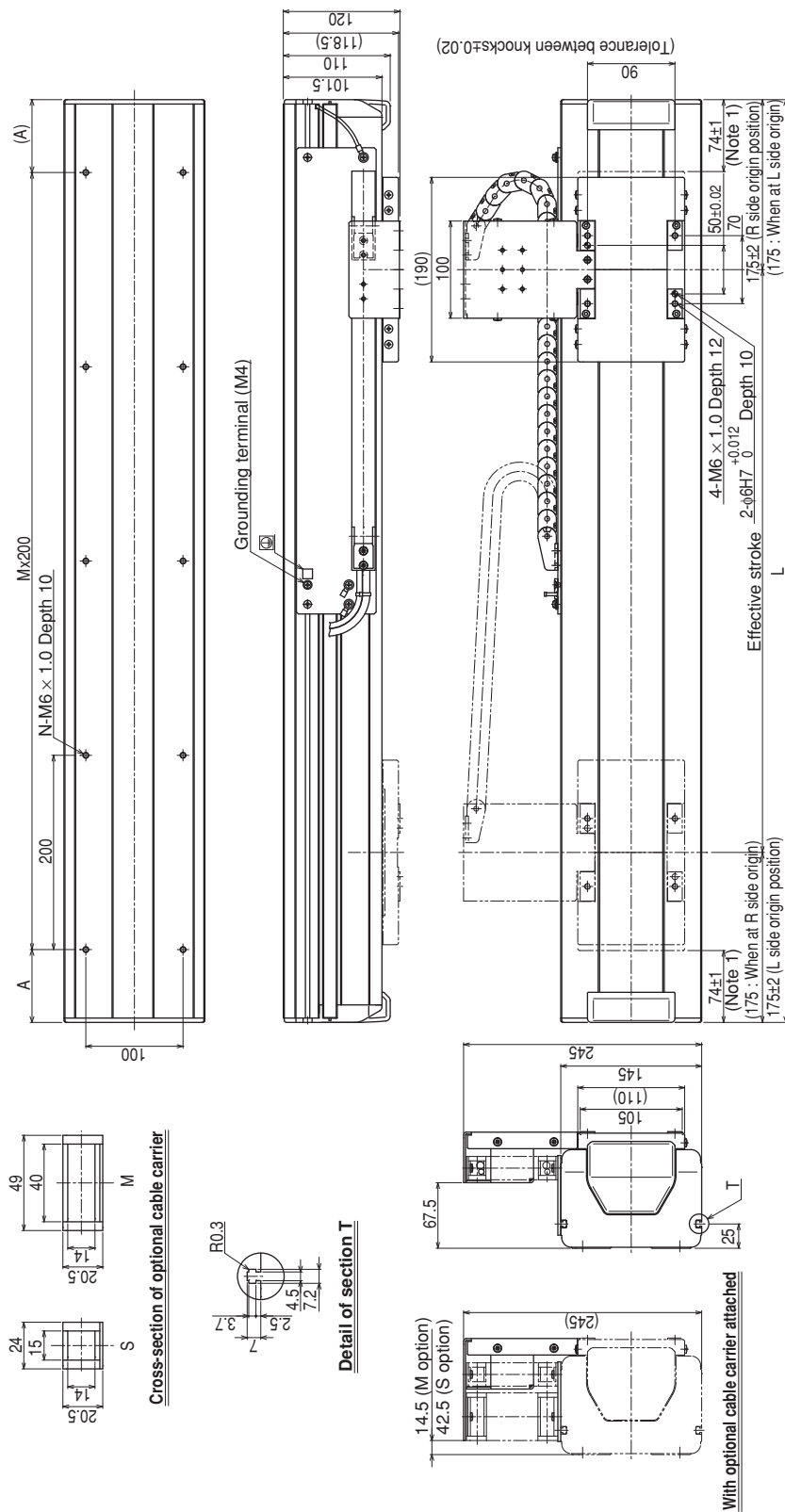


Note 1. Distance from both ends to the mechanical stopper.

\* The origin is set on the L side at the time of shipment. It can be changed to the R side by parameter setting.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
L	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350
A	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75
M	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11
N	6	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
Weight (kg)	11.5	13.0	14.5	16.0	17.5	19.0	20.5	22.0	23.5	25.0	26.5	28.0	29.5	31.0	32.5	34.0	35.5	37.0	38.5	40.0

## MR20 single-carriage wall mount model



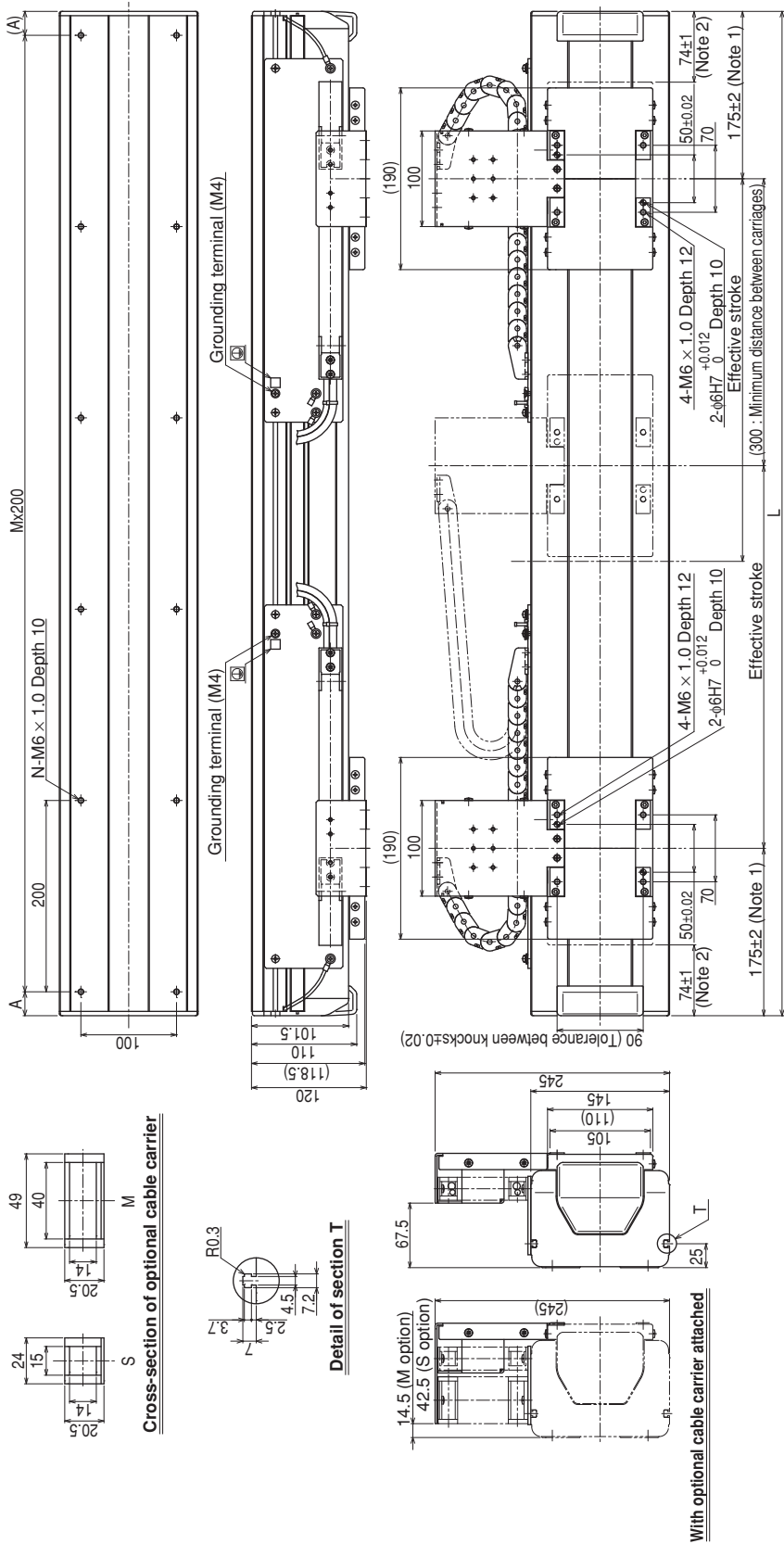
Note 1. Distance from both ends to the mechanical stopper.

\* The origin is set on the R side at the time of shipment. It can be changed to the L side by parameter setting.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
L	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350
A	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75
M	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11
N	6	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
Weight (kg)	11.5	13.0	14.5	16.0	17.5	19.0	20.5	22.0	23.5	25.0	26.5	28.0	29.5	31.0	32.5	34.0	35.5	37.0	38.5	40.0



MR20D double-carriage wall mount model



Note 1. Position of the table slider when returned to the origin.  
Note 2. Distance from both ends to the mechanical stopper.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700
L	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350
A	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75
M	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11
N	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
Weight (kg)	20.0	21.6	23.1	24.7	26.2	27.8	29.3	30.9	32.4	34.0	35.5	37.1	38.6	40.2	41.7	43.3	44.8



## 7-1-5 MR25/MR25D

### ● Basic specifications

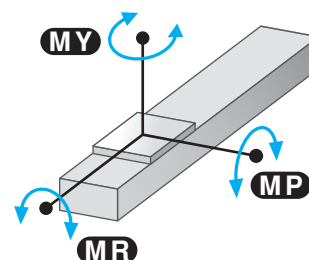
Robot model	MR25	MR25D
Repeatability (positioning accuracy)	Within $\pm 5\mu\text{m}$	
Maximum cross-section outside dimensions	W145×H120mm (excluding cable carrier)	
Total length	Stroke length +350mm	Stroke length +650mm
Bearing method	2 guide rails and 4 bearing blocks (with retainers)	
Drive system / shaft diameter	Shaft motor / 25mm diameter	
Scale	Magnetic method: resolution $1\mu\text{m}$	
Rated thrust	90N	
Maximum payload	23kg	
Maximum speed	2500mm/sec <sup>*1</sup>	
Maximum stroke	2000mm	1700mm
Maximum stroke	SRCP, SR1-P, RCX221, RDP	

<sup>\*1</sup>: Maximum speed may not be obtained depending on operating conditions.

### ● Static loading moment

(Unit: N·m)

MY	MP	MR
306	306	269



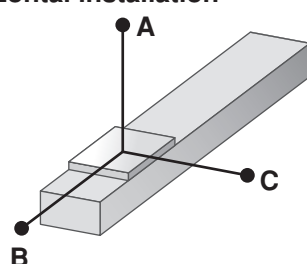
### ● Tolerable overhang amount <sup>\*2</sup>

(Unit: mm)

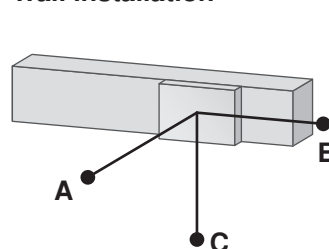
	Horizontal installation			Wall installation		
	A	B	C	A	B	C
5kg	3000	3000	1286	1288	2650	2556
10kg	2478	1745	749	703	1202	1886
17kg	1943	1056	426	394	606	1444
23kg	2248	801	379	279	385	1409

<sup>\*2</sup>: Distance from center of slider top to center of gravity of object being carried.

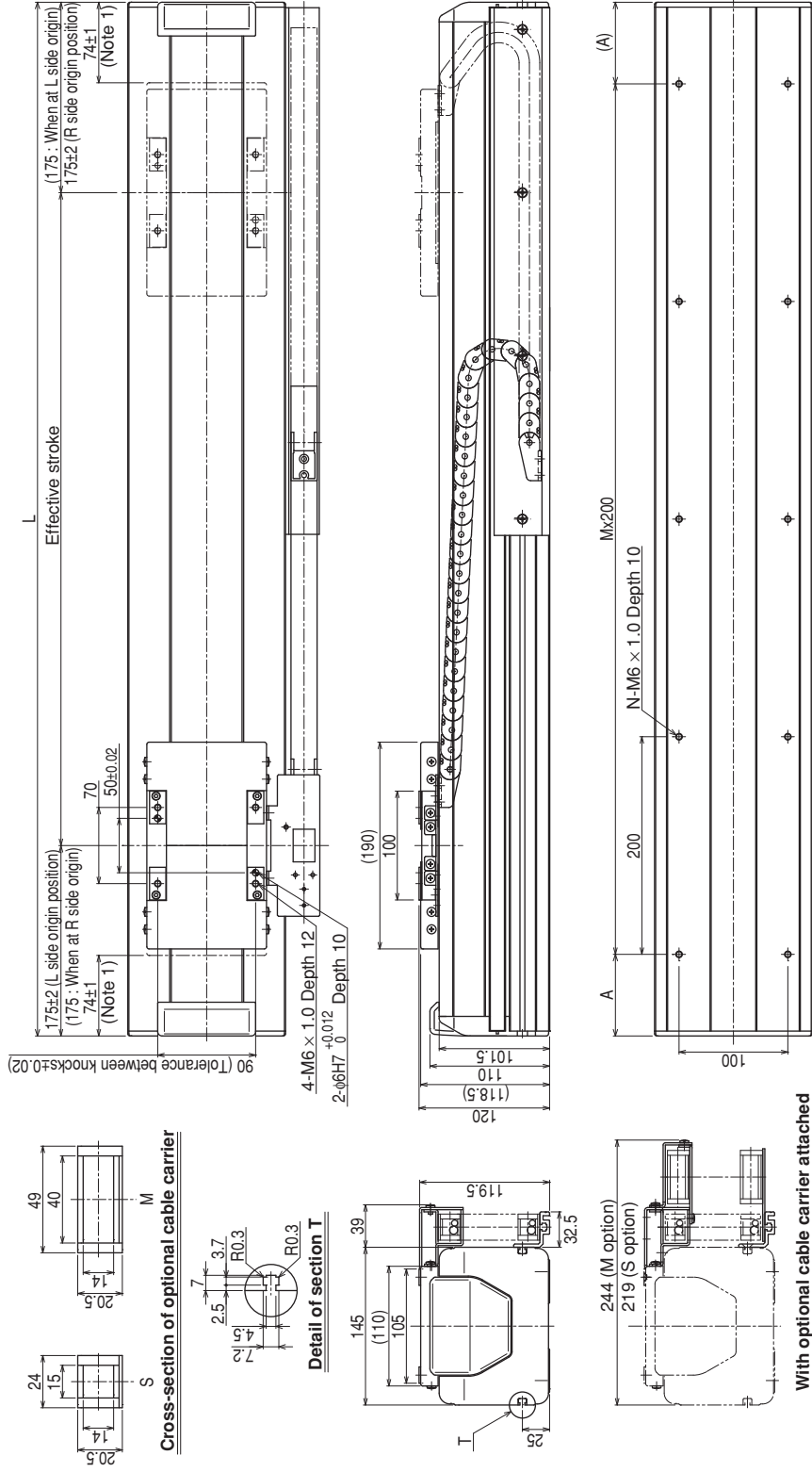
Horizontal installation



Wall installation



## MR25 single-carriage horizontal mount model

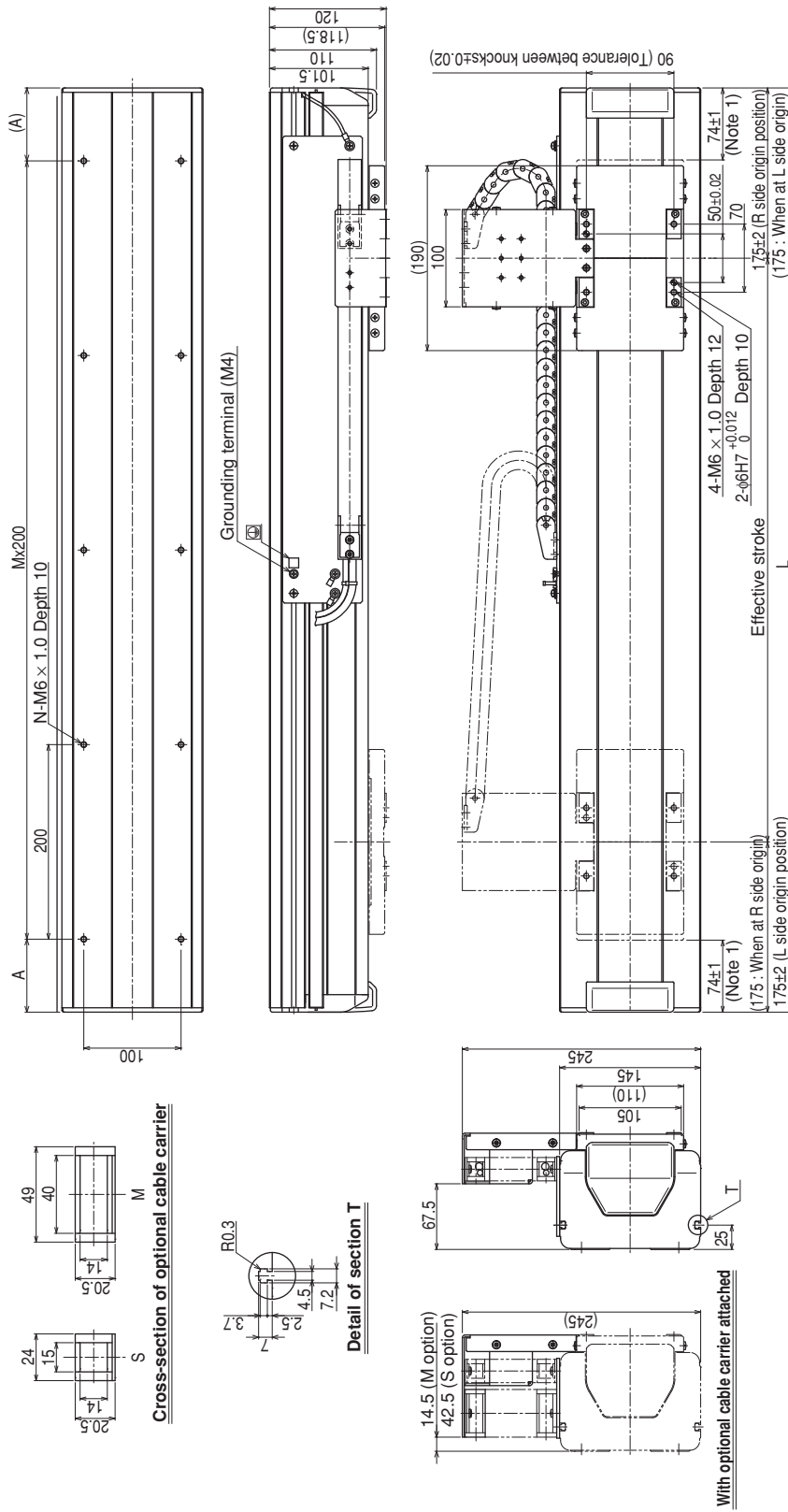


Note 1. Distance from both ends to the mechanical stopper.

\* The origin is set on the L side at the time of shipment. It can be changed to the R side by parameter setting.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
L	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350
A	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75
M	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11
N	6	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
Weight (kg)	11.6	13.5	15.3	17.2	19.0	20.9	22.7	24.6	26.4	28.3	30.1	32.0	33.8	35.7	37.5	39.4	41.2	43.1	44.9	46.8

## MR25 single-carriage wall mount model



Note 1. Distance from both ends to the mechanical stopper.

\* The origin is set on the R side at the time of shipment. It can be changed to the L side by parameter setting.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
L	450	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350
A	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75
M	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11
N	6	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
Weight (kg)	11.6	13.5	15.3	17.2	19.0	20.9	22.7	24.6	26.4	28.3	30.1	32.0	33.8	35.7	37.5	39.4	41.2	43.1	44.9	46.8

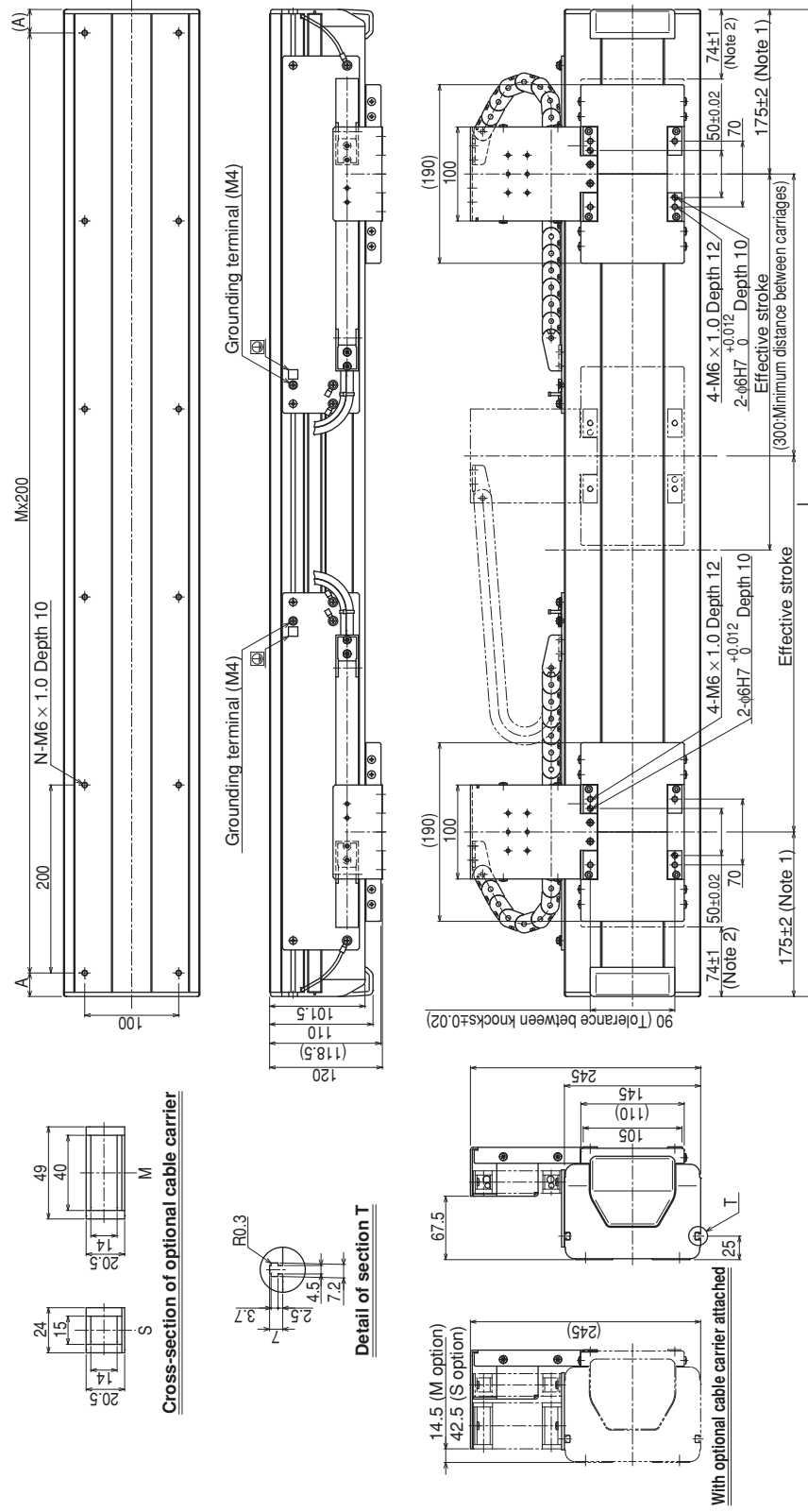
**7-24**



Note 2. Distance from both ends to the mechanical stopper.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700
L	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350
A	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75
M	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11
N	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
Weight (kg)	21.3	23.2	25.1	27.0	28.9	30.8	32.7	34.6	36.5	38.4	40.3	42.2	44.1	46.0	47.9	49.8	51.7

## MR25D double-carriage wall mount model

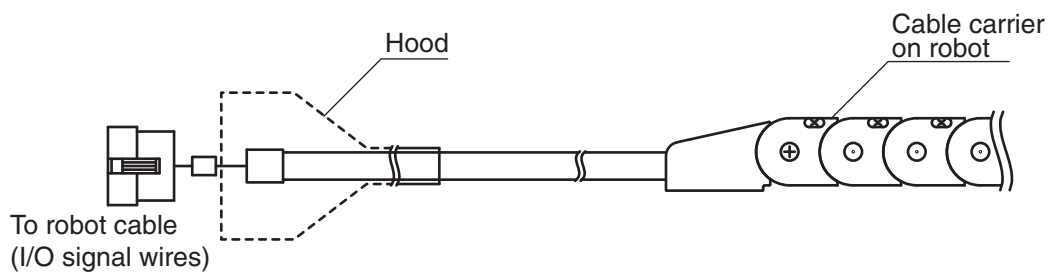


Note 1. Position of the table slider when returned to the origin.

Note 2. Distance from both ends to the mechanical stopper.

Effective stroke	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700
L	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050	2150	2250	2350
A	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75	25	75
M	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11
N	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
Weight (kg)	21.3	23.2	25.1	27.0	28.9	30.8	32.7	34.6	36.5	38.4	40.3	42.2	44.1	46.0	47.9	49.8	51.7

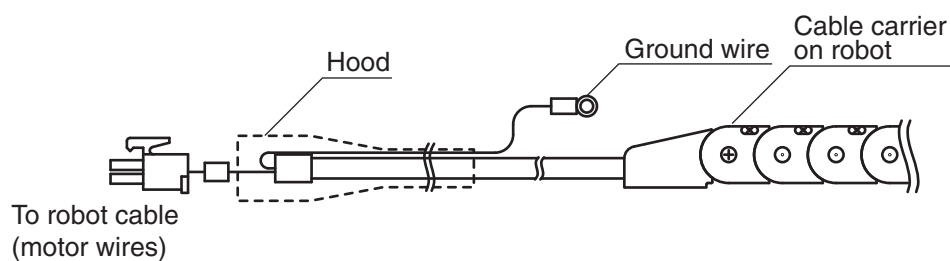
7-2 Robot connector (I/O signal connector)



Signal	Pin No.	Connection	Pin No.*	Remarks	
S+	1		1	Blue	0.15mm <sup>2</sup> twisted pair
S-	2		2	Orange	
C+	3		3	Green	
C-	4		4	Brown	
Z+	5		5	Gray	
Z-	6		6	Red	
+5 V	7		7	Black	
D.G	8		8	Yellow	
F.G	9		9	Shield	

\*Internally connected

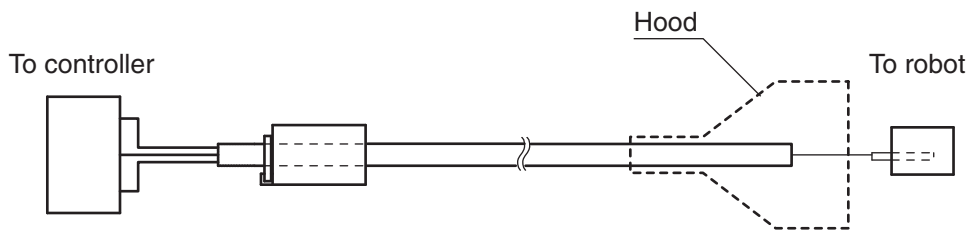
## 7-3 Robot connector (motor connector)



Signal	Pin No.	Connection	Pin No.*	Remarks
Motor wire FG	Round terminal		4	0.5 mm <sup>2</sup> Green
U	1		1	0.5 mm <sup>2</sup> Red
V	2		2	0.5 mm <sup>2</sup> White
W	3		3	0.5 mm <sup>2</sup> Black

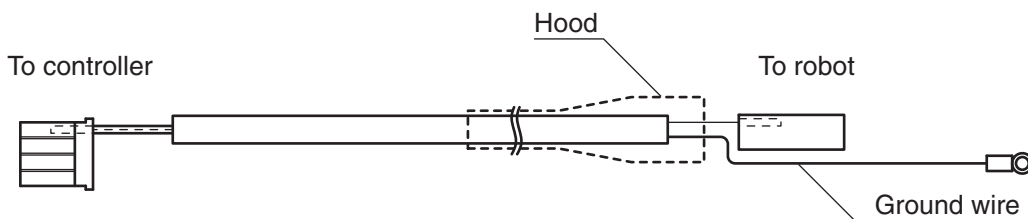
\*Internally connected

## 7-4 Robot cable (I/O signal wires)



Controller connector	Pin No.	Connection	Pin No.	Signal	Remarks
ROB I/O	1		1	S+	0.15 mm <sup>2</sup> Blue
	2		2	S-	0.15 mm <sup>2</sup> Orange
	3		3	C+	0.15 mm <sup>2</sup> Green
	4		4	C-	0.15 mm <sup>2</sup> Brown
	7		5	Z+	0.15 mm <sup>2</sup> Gray
	8		6	Z-	0.15 mm <sup>2</sup> Red
	5		7	+5V	0.15 mm <sup>2</sup> Black
	6		8	D.G.	0.15 mm <sup>2</sup> Yellow
	20		9	FG	

## 7-5 Robot cable (motor wires)



### ● SRCP

Controller connector	Signal	Pin No.	Connection	Pin No.	Remarks
MOTOR	Motor wire FG	1		Round terminal	0.75 mm <sup>2</sup> Yellow/Green
	U	2		1	0.75 mm <sup>2</sup> Red
	V	4		2	0.75 mm <sup>2</sup> White
	W	3		3	0.75 mm <sup>2</sup> Black

### ● RCX

Controller connector	Signal	Pin No.	Connection	Pin No.	Remarks
MOTOR	Motor wire FG	1		Round terminal	0.75 mm <sup>2</sup> Yellow/Green
	U	2		1	0.75 mm <sup>2</sup> Red
	V	3		2	0.75 mm <sup>2</sup> White
	W	4		3	0.75 mm <sup>2</sup> Black



## MEMO

## Revision record

Manual version	Issue date	Description
Ver. 2.02	Jun. 2009	Addition of cautions about the magnetic scale.
Ver. 2.03	Oct. 2009	Clerical error corrections.
Ver. 2.04	Dec. 2009	The address and other information were added to the front cover.
Ver. 2.05	Mar. 2010	Some explanations were corrected or added in "Chapter 1 Using the Robot Safely". Addition of procedure for applying grease to MR20/25. Clerical error corrections, etc.
Ver. 2.06	Jun. 2011	The description regarding "Warranty" was changed.
Ver. 2.07	Jul. 2012	The description regarding "Warranty" was changed.

## User's Manual

**YAMAHA**  
Linear Single-axis Robots

PHASER series  
**MR**Type

Jul. 2012

Ver. 2.07

This manual is based on Ver. 2.07 of Japanese manual.

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